

HEIDENHAIN is Expanding to the Desert

News agencies throughout the world reported on July 14, 2007, about the trial run of the largest reflecting telescope in the world, the Gran Telescopio de Canarias (also known as GranTeCan) the previous evening. Astronomers, appropriately enough, designate the milestone when light first reaches the mirror as first light. Notably, encoders from HEIDENHAIN are used in controlling this telescope, as well as on almost all other new telescopes of these dimensions. For example, an ERA 780C scale tape with 12 scanning heads and a diameter of 15 meters was installed on the azimuth axis. This is the largest of all ERA angle encoders that have been installed anywhere in the world. But from HEIDENHAIN's point of view, this project is already history—the R&D phase was completed years ago, and HEIDENHAIN's last active participation was during the installation of the angle encoders in the fall of 2005.

However, on the same day that news of GranTeCan's first light spread through the world, HEIDENHAIN was awarded the contract for the next large telescope: ALMA. The Atacama Large Millimeter Array project (known as ALMA) is an international collaboration between the USA, the European Union, Japan and Chile.

The ALMA project

The ALMA project consists of an array of radio telescopes, and is intended for the observation of electromagnetic waves with a wavelength of about 0.85 mm to 3 mm.

For the first time in the history of radio astronomy, the resolution of the largest optical telescopes, such as the VLT (the ESO's Very Large Telescope in Chile) or the Keck telescope (on Mauna Kea, Hawaii), is being matched. Many heavenly objects have not been visible despite the high resolution of optical telescopes, since they are obscured by cosmic dust. Radio telescopes do not have this problem. This will make it possible to observe such important astronomical events as the creation of stars and planets.

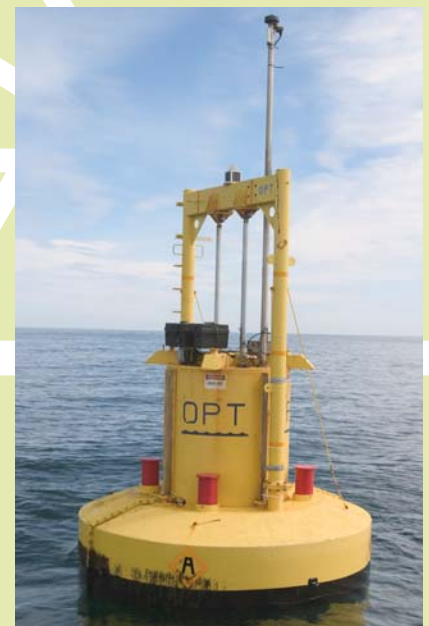
A further motivation for high-resolution radio astronomy with ALMA is the observation of very distant galaxies whose electromagnetic waves reach us very strongly red-shifted, since they are moving away from us at such high speeds. This places them in ALMA's spectral observation window. Naturally the large distance results in a very low intensity of the radio waves. ALMA's large receptive surface permits the observation of even more distant heavenly objects, which sent out their electromagnetic waves at a time when the universe was just 8% of its present age. Precise measurements by the WMAP

continued on next page

Did You Know...

...that HEIDENHAIN's ECN 413 absolute encoders are used in an innovative ocean wave energy-making system? This system developed by **Ocean Power Technologies, Inc.** (OPT) (www.oceanpowertechnologies.com) uses a "smart" ocean-going **PowerBuoy**® to convert wave energy into low-cost, clean electricity. This system is currently in use off the coast of New Jersey, and more projects are underway in Hawaii, Spain, Scotland and Oregon.

The PowerBuoy® is an offshore wave energy converter, most of which is submerged below the water's surface. Inside, a piston-like structure moves as the PowerBuoy® bobs with the rise and fall of the waves. This movement drives a generator, producing electricity, which is sent to the shore by an underwater cable. An OPT "power plant" will consist of an array of identical PowerBuoys® that are electronically connected to provide the desired power capacity. A 10-Megawatt OPT power station would occupy only approximately 30 acres (0.125 square kilometers) of ocean space. It is scalable to large power stations (100+ MW). Within each PowerBuoy® is a rugged high efficiency large diameter **TMB 760 torque motor by ETEL, Inc.** (www.etelusa.com) which is the generator. Within that is a **HEIDENHAIN ECN 413** absolute encoder mounted in order to evaluate position. These absolute encoders



The PowerBuoy® is an offshore wave energy converter

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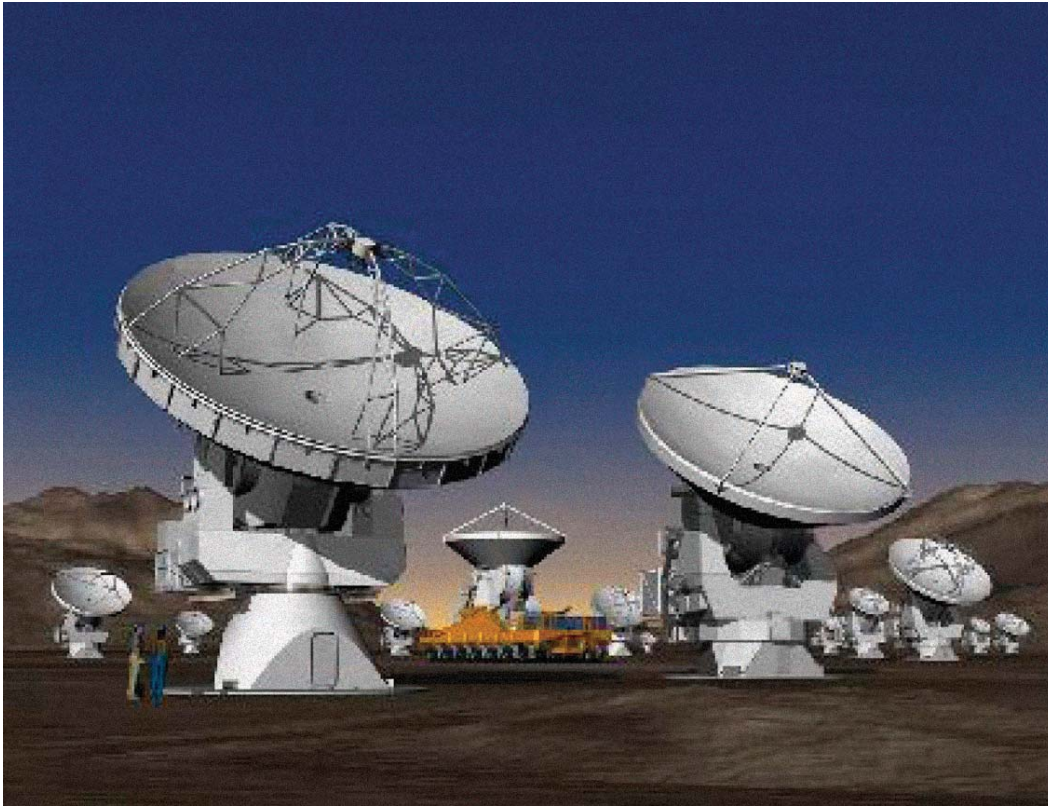


Figure 1: Illustration of the ALMA antennas (photo: ESO)

satellite show that the age of the universe can be estimated relatively well, at 13.7 billion years. This means that the waves recorded traveled up to 12.6 billion years before they reached us. ALMA will help to gather more detailed information about the composition of the early universe. On the other end of the distance spectrum, ALMA's high degree of resolution is also intended as an aid in the improved observation of the comets, asteroids and planets of our solar system.

The telescope consists of 64 main antennas—each 12 meters in diameter—and 12 auxiliary antennas. These antennas will be positioned on the Atacama desert plateau in Chile, at an elevation of 5000 meters, over a field with a diameter of 5 km. The antennas can be positioned in different locations for each experiment, for example on the circumference of a 500-meter wide circle, or in one line over 5 km. The completion of this project was a severe challenge, for both man and machine. The elevation itself (5000 m is 16,400 ft!) makes all physical effort during construction, setup and normal operation much more difficult. A “base camp” will be established at 3000 m. The antennas will be assembled there, and special vehicles, developed precisely for this task, will bring them to the actual

site. These vehicles consumed a large share of the project investments, and will also transport the antennas when the array is rearranged for different experiments.

Each region involved in the ALMA project is represented by an organization from its region, and therefore contributes its own share. For Europe, the ESO (European Southern Observatory, located in Garching by Munich) is responsible for the setup of up to 32 antennas. The NSF (National Science Foundation, USA/Canada) will also prepare up to 32 antennas. The partners developed their antenna designs completely separately from each other, which explains the obvious visible differences.

Figure 1 shows the American antennas, and Figure 2 shows the European version. Japan is contributing 10 auxiliary antennas to the project. The design phase of the projects covered a longer period. HEIDENHAIN became involved in 1999, and continuously contributed to the project over the years.

ALMA and HEIDENHAIN

ESO's prototype antenna has already been equipped with angle encoders and interpolations electronics from HEIDENHAIN, and

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HEIDENHAIN's Revolutionary Encoder Interface is Faster Than Ever



Although it no longer needs to prove itself, the EnDat 2.2 encoder interface from HEIDENHAIN sets the standard once again. This bidirectional EnDat 2.2 interface is now available with a clock frequency of 16 MHz for high-response applications with direct drives, especially those found in the electronics industry. The increase from 8 MHz to 16 MHz significantly reduces the access time to the position value, and makes shorter cycle times possible. This means that EnDat 2.2 is now the fastest purely serial interface for position encoders based on the RS-485 transmission characteristics.

Interface electronics, with which the incremental encoder signals are made available to EnDat 2.2 as purely serial position information, are used in order to connect incremental encoders with 1-Vpp interface to subsequent electronics compatible with EnDat 2.2.

The EnDat interface, as a fast, bidirectional, purely serial, and therefore fully digital interface for high-response drives, yields significant savings in connection technology for the entire system as well as a reduction of required installation space in the machine. Since the analog scanning signals are digitized and subdivided directly at the place of measurement, characteristics of servo motors such as positioning accuracy and speed stability can be further improved. Along with the automatic self-configuration of encoders and drives in automation systems, the transmission of additional information, such as temperature, to the subsequent electronics is possible without additional wires. The online diagnostics capability of the interface ensures the availability of machines and facilities, and simplifies maintenance. ■

For more information, circle #1 on the reply card.

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the correct operation has been proven. The first series antenna is currently being built in Spain, and will later be shipped to Chile. In 2008, the first identical series antenna will be assembled at the base camp at 3000 meters. Every two months another antenna will be completed, and brought to its final location at 5000 meters. The construction phase of the project is planned to last until 2012, and then the array with all of its antennas will be ready.

HEIDENHAIN is supplying encoders of the newest generation. Each of the 25 antennas ordered will be equipped with ERA 4000 and ERA 7000 angle encoders. The azimuth axis—around which the antenna rotates along the horizon—is equipped with an ERA 4280C drum with four scanning heads. In contrast, the elevation axis is equipped with an ERA 7480C METALLUR scale tape approximately three meters in diameter and eight scanning heads. Entirely new electronics had to be developed in order to satisfy the demands of the project regarding the evaluation of the scanning signals.



Figure 2: Prototype antenna (photo: ESO)

Forecast

What does the future look like—will more large telescopes be constructed with the support of HEIDENHAIN?

The ESO and its North American counterpart are currently each performing studies regarding very large reflecting telescopes. The large dimensions, with mirror diameters of up to 42 meters, present brand new design and construction challenges. The metrology industry must also forge ahead on new paths for such projects. HEIDENHAIN is in contact with both project partners, with offers to continue to be used in the technologically most advanced telescope projects of the day.

Dr. Karsten Sändig (EMG, Fundamental Encoder Research) and Florian Schindler (M-MT, Marketing) work in close cooperation regarding large telescope projects worldwide. Sources for the images and technical details about the ALMA project: ESO (www.alma.info) ■

For more information, circle #2 on the reply card.

HEIDENHAIN's 2007 Distributor of the Year

In May, distributor Automation and Metrology, Inc. in Painesville, Ohio was presented with the prestigious 2007 HEIDENHAIN Distributor of the Year Award. This coveted annual award recognizes the HEIDENHAIN distributor who best represents excellence and commitment to the servicing industry, as well as HEIDENHAIN's highest standards. ■



Pictured here (from left to right) from Automation and Metrology are: Jennifer Bordelon (Customer Service), Dave Denman (Partner), Tom McManus (Sales/Service) and Mark Contorno (Partner). HEIDENHAIN Regional Manager Ron Hood on end. Look for a profile of Automation & Metrology in a future newsletter.

Automation & Metrology was a 2007 HEIDENHAIN Distributor of the Year finalist as they had been previously selected as one of HEIDENHAIN's monthly winners.

2007 HEIDENHAIN Distributors of the Month

January	Tool Crib Inc.
February	Controls for Motion Automation
March	CIM Technologies
April	Automation & Metrology
May	Morlin Inc.
June	Phoenix Inc.
July	S K Braly
August	Tool & Gage
September	Motion Industries
October	AMS
November	Dalatec
December	Promac

Improved Inductive Encoders Offer Better Control Performance



Due to improvements on the ECI/EQI 1300 series of inductive rotary encoders from HEIDENHAIN Corporation, a 19-bit singleturn resolution version is now offered, providing better machine control performance than ever before. This is a result of the addition of a new ASIC being implemented in 2008 on these encoders first introduced to the market about 10 years ago.

Because of these improvements, this ECI/EQI series also offers a multiturn encoder with a resolution of 31 bits.

Typical applications of these types of rotary encoders are in servo applications. ■

For more information, circle #3 on the reply card.

The Truth about EnDat continued from back page

One of the many benefits of EnDat is the integrated interpolation and the new and improved scanning method. Single-turn drive encoders provide 25 bits of pure digital resolution and an additional 12 bits for multi-turn versions, 37 bits of position data in pure digital form. Also, contamination plays even a smaller role with the newly developed scanning technique making it nearly impervious.

box configures 1 Vpp output signals to be able to communicate via EnDat. Regarding temperature sensors, EnDat offers the ability to implement temperature sensors without additional signal lines.

Lastly, let's review the different ordering designations because, quite frankly, I get confused as well:

Order Designation (*) (2)	Power Supply (*)	Command Set	Version	Max Clock Frequency (5)
EnDat 01	See technical data of encoder	See technical data of encoder	w / inc signals	≤ 2 MHz
EnDat 21			w/o inc signals	
EnDat 02	Extended power supply Range: 3.6 ≥ Up ≥ 5.25V (1)	EnDat 2.2	w / inc signals	≤ 2 MHz (2, 3) 8 ≤ f CLK ≤ 16 MHz (2, 4)
EnDat 22			w / inc signals	8 ≤ f CLK ≤ 16 MHz (2, 4)

- (*) Indicated on the ID label
- (1) Exception EIB: Power supply 5V +/- 10%
 - (2) Value can be read out via parameter
 - (3) For encoders with attached cable assemblies
 - (4) For encoders with separate cable assemblies
 - (5) Consider maximum allowable cable length!

Also, we are all aware of the breadth of the HEIDENHAIN product line, i.e., rotary, angle, with and without bearing, as well as linear and gauging encoders. We offer an interface box that allows the customer to utilize one interface for all controlled axes and that interface is EnDat. The EIB interface

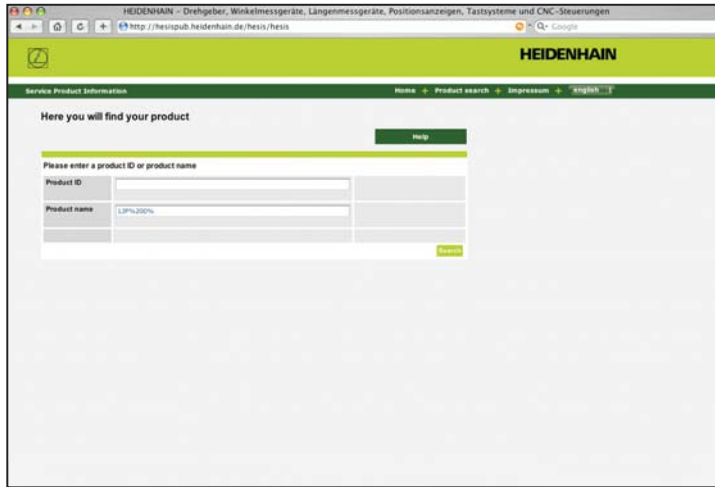
I hope this helps. And remember, if you have any questions at all, you are welcome to put our area sales managers to the test. Oh yes, before I forget, EnDat® stands for Encoder Data. Enjoy your Summer everyone!

For more information, circle #4 on the reply card.

HEIDENHAIN Web Site Expands

In response to customer's requests and to better support our wide customer base, a new section called HESIS Public has been added to **www.heidenhain.com** that will facilitate easy access to information regarding older HEIDENHAIN products for OEMs, distributors and end users.

For example, just by administering a few clicks starting with the **Services and Documentation** tab, then **Technical Service**,



all site users can access a Service Product Information page where a Product ID or Product Name field will come up allowing users to enter that information for even older product and receive mounting instruction, for example.

In the Member-Area, registered partners can be brought to HESIS-Web for even more information such as that of spare parts, testing equipment and repair descriptions for all HEIDENHAIN Products. ■

Check it out!

Dear Abbé...

Q: "Why does HEIDENHAIN talk about accuracy when many of your competitors talk only about resolution? What is the difference? How is repeatability related?"

A: Accuracy, Repeatability and Resolution, while related to each other, are separate issues.

In the example on the left, the resolution is the size of the bulls eye and rings

• **Not all applications require accuracy**

- If you need to drill 10 holes then go back and tap them within .05", repeatability is more critical

• **Resolution determines repeatability**

- If your resolution is .0002", your repeatability cannot be better than .0002"
- If you increase your resolution (example: parameter setting on DRO) to .0001", your repeatability is now .0001"

Sincerely,
Abbé

If you have a question for Abbé, please send it to us by filling out the "Question for Dear Abbé?" section on the reply card.

*Not accurate,
not repeatable*

*Very repeatable,
not very accurate*

*Very accurate,
very repeatable*

Accuracy - Degree of conformity of a measure to a standard or true value.

Repeatability - The closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions, approaching from the same direction, for full-range traverses.

Resolution - The least interval between two adjacent discrete details which can be distinguished one from another.

Visit HEIDENHAIN on the Road

HEIDENHAIN will host exhibits at the following remaining 2008 trade shows. Come by and see what's hot! ■

SEMICON

July 15-17
Moscone Center – North
San Francisco, California



IMTS

Sept. 8-13
McCormick Place
Chicago, Illinois



National Manufacturing Week

September 23-25
Donald E. Stephens Convention Center
Rosemont, Illinois



American Society for Precision Engineering (ASPE)

October 21-23
Marriott Downtown Waterfront Hotel
Portland, OR



Did You Know... *continued from cover*

are characterized by their integral bearing and mounted stator couplings. The hollow shaft of this encoder is slid directly onto the shaft to be measured. During angular acceleration of the shaft, the stator coupling must absorb only that torque caused by friction in the bearing, therefore providing excellent dynamic performance and a high natural frequency.

“We’ve been using the HEIDENHAIN encoder in our system for two years, including throughout our testing procedures,” explained Tim Liska, OPT Director, Electrical Engineering, “and everything’s been working great. All is coming together nicely, and we are thrilled to be a key component to meeting the future energy needs of utilities, independent power producers and the public sector alike.” ■

For more information, circle #5 on the reply card.

Technical Tidbit:

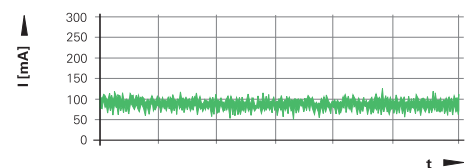
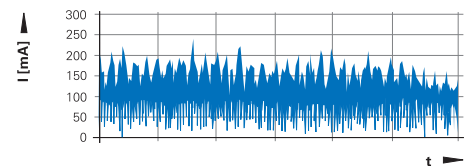
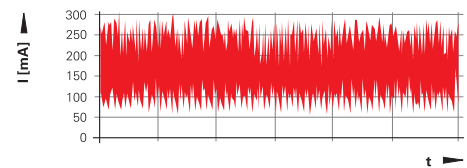
Resolution and Velocity Control

When determining the performance of electrical drives, it is important to consider not only the design and properties of the control but also the measuring technology used. The positioning accuracy and speed stability behavior of these machine axes significantly determine the quality of the work-piece and/or processes. This necessitates a position encoder with a large number of measuring steps and high signal quality.

Irregularities in the speed stability can be caused by mechanical influences from the drive train as well as by position errors resulting from the encoder technology used. If the resolution of the measured signals is too low, or if the interpolation error is too high, wave-like errors can appear on the work-piece surface. The speed stability of certain motions in production systems can also be considered as a production parameter relevant to the quality.

Higher resolutions and accuracies can decisively improve the speed stability behavior of the motor. In addition, disturbances in the motor current are reduced significantly. The motor operates quietly and develops only a small amount of heat.

Ideal output signals with high resolution support a high bandwidth, which means that load variations only have a minimal effect on the rotational speed. ■



- Resolver: 1 signal period per revolution
- EQI inductive rotary encoder: 32 signal periods per revolution
- EQN optical rotary encoder: 2048 signal periods per revolution



By Tom Wyatt
National Sales and Product Manager, Automation



The Truth about EnDat

OK everybody, it's time to clear the air about EnDat, our exceptional encoder interface. It seems our competition loves to talk about it in the way of comparison charts and quotes in articles found on the Internet and in some publications, but I've seen many inaccuracies.

Don't get me wrong, we like the free publicity and it is clear that EnDat is making an impact in the industry. However, I do want to make sure that the small details are clear to everyone.

The EnDat interface from HEIDENHAIN is a digital, bidirectional interface for encoders. It is capable both of transmitting position values from incremental and absolute encoders as well as transmitting or updating information stored in the encoder, or saving new information. Thanks to the serial transmission method, only four signal lines are required. The data are transmitted in synchronism with the clock signal from the subsequent electronics. The type of transmission (position values, parameters, diagnostics, etc.) is selected by mode commands that the subsequent electronics send to the encoder. The EnDat interface transmits position values or additional physical quantities in a temporally unambiguous sequence and serves to read out from and write to the encoder's internal memory.

First I want to make sure that everyone realizes that there is **NO LICENSING FEE** and, yes it's true, EnDat is not available to other encoder manufacturers. For support regarding implementation, the company MAZeT provides the necessary support for an FPGA.

The FPGA soft macro of the EnDat 2.2 interface describes the part of the interface on the control (referred to as the master component) between absolute position encoders from HEIDENHAIN and the user's subsequent electronics.

The implementation of the EnDat 2.2 interface as master component in the form of an FPGA soft macro (FPGA-EDIF net-list) is intended for various FPGA families. The large scope of function of the FPGA soft macro ensures an effective distribution of all tasks of the control between the EnDat master component and the microcontroller.

<http://www.mazet.de/>

Next, I wanted to mention that EnDat 2.2 encoders are approved for functional safety unlike other serial interfaces, meaning SIL 2 category 3 for a single EnDat 2.2 encoder. The approval was issued by the BGIA in Europe.

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