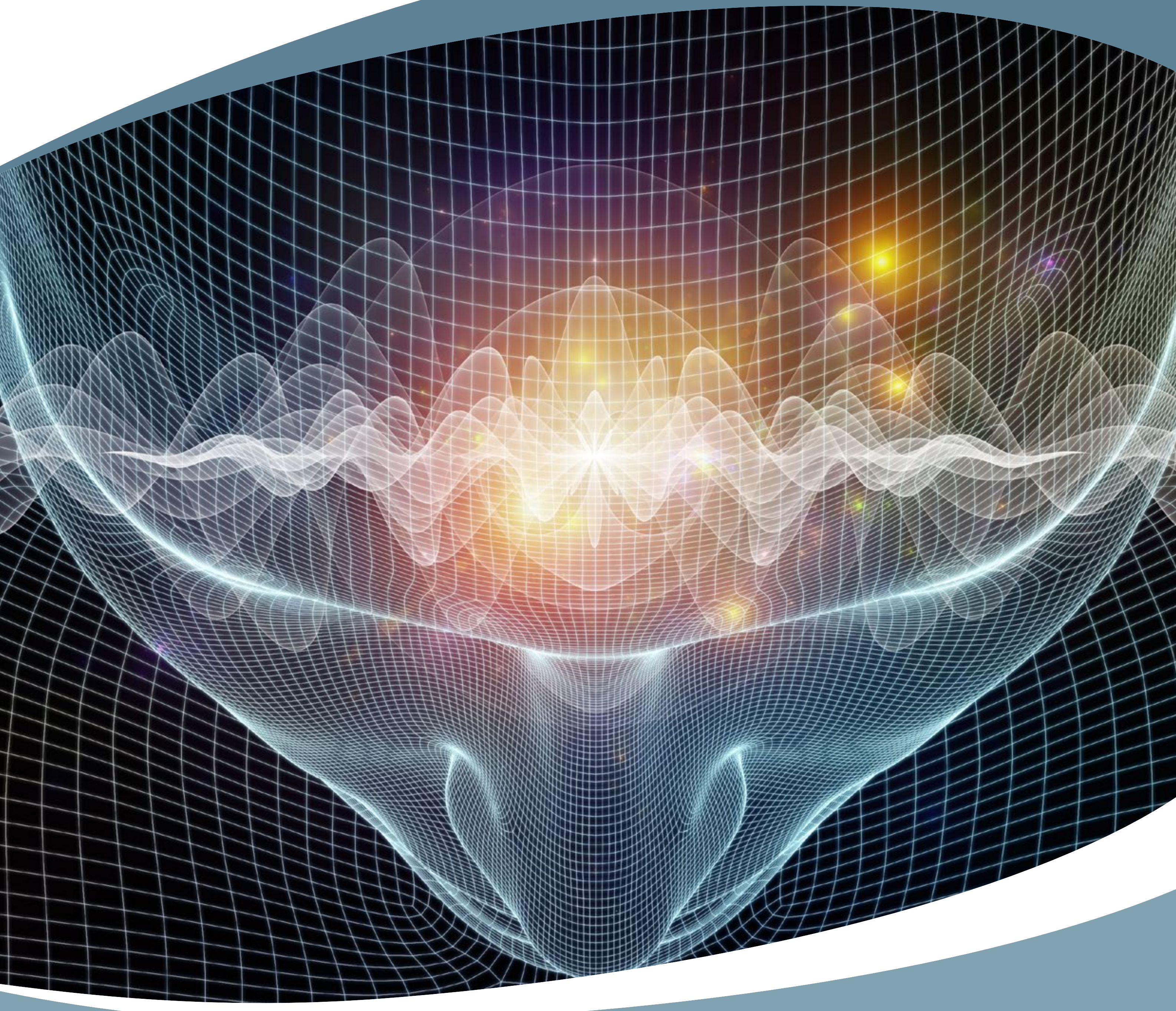
WE MAGNETISE THE WORLD



Switching solenoids intelligently

Technology Brief

INDUSTRIAL CONTROL SYSTEMS KUHNKE

Think outside the box!

Switching solenoids intelligently

The term mechatronics describes the interaction of mechanics and electronics. With a newly developed technology to control solenoids, Kendrion Kuhnke uses electronic intelligence to accelerate the switching process and add more efficiency to any linear solenoid or solenoid valve.

Generally speaking, solenoids offer a very simple functionality. They only know two operating conditions and are either powered and active or powerless and in a passive state. This means all that needs to be done is to switch them on and off. At least principally speaking.

One problem with solenoids is that they are mechanical components. This means they have an inherent moment of inertia and are subject to certain physical laws. Plus they feature a magnetic coil that needs some time to develop a sufficiently strong magnetic field and break down that field again. But time has become a valuable asset in today‘s industrial environment which expects any new machine to be faster and more economical than the previous model.

This very issue was the subject of a bachelor thesis by Lukas Bremer. Bremer is a system developer specializing in control technology at Kendrion Kuhnke in Malente, Germany. He tried to figure out how solenoids can be used more effectively instead of simply switching them on and off. His efforts resulted in a new technology allowing a more targeted and intelligent control of solenoids in order to operate them considerably faster and more efficiently.

The basic principle is based upon a T2 D2 bridge that allows a more precise flow of current through the magnetic coil of the solenoid. It only calls for a few components and is controlled via a microcontroller.

During the switching process, the coil is initially supplied with a higher power which will be reduced to a lower level as soon as the solenoid has reached its holding position. This initial over-energizing of the coil contributes to considerably faster switching. At the same time, the reduced current used for keeping the solenoid in its holding position lowers the power loss by 50 %. Especially with larger solenoids this results in substantial energy savings.

The exact timing for this power reduction is determined by the controller. It monitors the typical current flow during the switching process in order to detect when the solenoid has reached its end position – without the need of any additional sensors.

Another advantage of this intelligent technology is an active energy recovery during the process of switching off the solenoid. During this operation, the T2 D2 bridge is used so that the energy stored in the coil not only unloads faster, but also flows back into the electric circuit. This reduces the time for discharging the magnetic field by 90 % which also contributes to faster switching.

But that‘s not all. Once the coil armature has reached its end position, stiction forces will try to keep it in this position. When switching off the power, these forces need to be overcome first before the armature can return into the starting position. The integrated dithering function of the new control technology counteracts this effect. It causes the armature to perform constant minimal motion which eliminates the stiction effect and allows the solenoid to react much faster.

The combination of all these features will accelerate the speed of any solenoid by up to 80 % while considerably improving the efficiency.

The very first product featuring this newly developed technology is the Kuhnke FIO PWM AO-I. This new controller is especially designed for inductive drives and available with 2 or 4 PWM outputs. It allows standard rail mounting and supports easy integration into any machine control system via EtherCAT®, CAN or TS 485.

The controller allows comprehensive configuration and can be tailored to any solenoid system. For precise switching control, parameters are provided via the data bus or are stored in the controller itself.

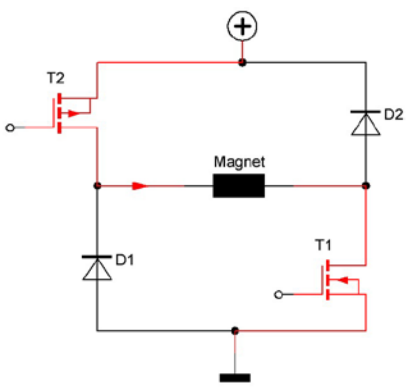
Depending on customer requirements, it is even possible to integrate such an intelligent control into a specific module. The module is directly attached to a solenoid-controlled switch or valve and tailored to the specific operating parameters of the device.

Nico Heinrich, Control Technology Product Manager at Kendrion Kuhnke is aware of the importance of this new technology: “Once again, Kendrion Kuhnke positions itself as a solution partner that is able to anticipate customer requirements at an early stage by translating technical advancements into tangible customer benefits.”

Kuhnke FIO PWM AO-I

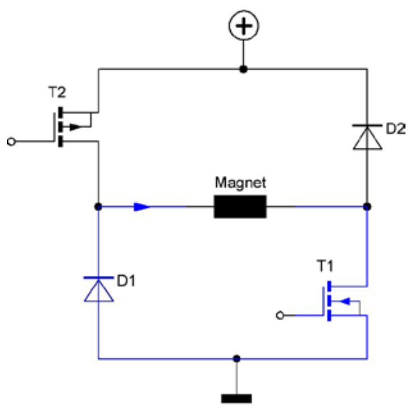
The operating principle

Power On



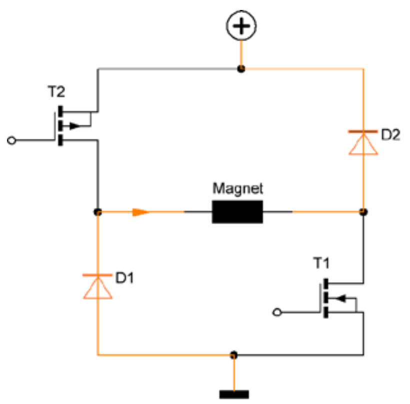
Closing transistors T1 and T2 supplies the full operating voltage, resulting in an over-energized and therefore faster switching procedure. After reaching the end position, the holding current limiter will automatically reduce the power loss of the solenoid.

Power Off



The voltage can be switched off, when transistor T2 is opened and transistor T1 is closed. This is the de-energized position in which the generation of electromotive force due to the magnetic field is disengaged.

Feedback



When you shut off the source power, both transistors T1 and T2 will be switched off, thus discharging the magnetic field via the diodes D1 and D2 thru source.

KENDRION

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