September 2018

CAN Newsletter

Hardware + Software + Tools + Engineering

Electricity in the blood

Customized CAN-connectable electronics

VCIs for the entire vehicle lifecycle

Motion control platforms suitable for CiA 402

CAN in the days of US tariff battles and the German export surplus

Devices

Hardware & Software for CAN Applications

PCAN-Explorer 6

Professional Windows® Software to Communicate with CAN and CAN FD Busses

The PCAN-Explorer is a versatile, professional Windows® software for the observation, control, and simulation of CAN busses. Besides CAN 2.0 A/B, the PCAN-Explorer 6 now also supports the CAN FD standard with up to 64 data bytes per CAN message.

Features

- Simultaneous connections with multiple CAN interfaces independent of their hardware type
- Support for the CAN specifications 2.0 A/B and FD
- Transmission of CAN FD data with bit rates up to 12 Mbit/s
- Clear display of the CAN traffic with various information
- Configurable symbolic message representation
- Easy manual and periodic message transmission
- Data logging with tracers and the 4-channel Line Writer
- Playback of trace files with optional loop function
- Multiple flexible filters, also usable for recorded trace files
- Automation of small tasks or complex processes with macros or VBScript
- Management of settings, information, and files in projects
- Export of entire projects including linked files to handy packets for archiving or sharing

Optional functionality upgrades:

- Plotter Add-in: Recording and graphical representation of multiple signal sequences
- Instruments Panel Add-in: Representation of digital and analog signals via graphical instruments for easy simulation of complex CAN applications
- J1939 Add-in: Support for functions of the SAE J1939 network protocol
- CANdb Import Add-in: Direct use and optional import of CANdb files

System requirements

- Windows® 10, 8.1, 7 (32/64-bit)
- At least 2 GB RAM and 1.5 GHz CPU
- For the CAN bus connection: PC CAN interface from PEAK-System
- Free USB port for copy protection dongle (only for portable license)

Training:

We offer training sessions for the PCAN-Explorer and CAN basics for groups or individuals. If you are interested, please contact training@peak-system.com.

www.peak-system.com

Take a look at our website for the international sales partners. Scan the QR code on the left to open that page.

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Applications

Protocols

IAS China: CiA on the German Pavilion

The Industrial Automation Show (IAS) takes place in Shanghai from September 19 to 23. CAN in Automation (CiA) exhibits in hall 5.1, stand B022 on the German Pavilion. The tradeshow offers a platform for products and services on industrial automation, electric systems, robotics, and IT solutions. On the CiA booth, the member companies ESD and Kvaser show their products.
The IAS takes place in parallel to the MWCS (Metalworking and CNC Machine Tool Show). Last year, the two exhibitions attracted over 600 brands within a display area of 70 000 m^2. The five-day event attracted over 16 000 visitors. This year, the IAS is scheduled on the weekend, which could decrease the number of professional visitors.

CAN protocol enhancement

This article describes the enhanced CAN protocol called CAN-HG and the features of the IC circuitry from Canis that implement it.

CAN-HG has been designed to meet two important requirements: Increasing the bandwidth and guarding the network. There is a third requirement – and this requirement is the most important: the protocol enhancement must be completely compatible and interoperable with Classical CAN. It must run on existing wiring with existing nodes using legacy CAN controllers in legacy micro-controllers. Any approach that requires every node on a bus to be re-developed for new micro-controllers is infeasible: it must be possible to freely mix Classical CAN and CAN-HG on the same network segment.

Increasing the throughput

The bit time in CAN is set according to the electrical characteristics of the physical CAN network and the dominant factor is the propagation time across the bus: CAN arbitration requires that there is sufficient time for all nodes to signal a bit and for the signal to have reached all other nodes before the line is sampled. After arbitration has been decided this propagation time constraint no longer applies and shorter bit times could be adopted. But a new frame format, in which there is a switch to faster signaling causes compatibility problems: legacy CAN controllers cannot follow the new frame format and would typically generate error frames and drive the transmitter into bus-off state. CAN-HG solves this problem with the notion of a carrier frame.

A carrier frame is a CAN frame with a payload of 8 byte fixed to 30 00 00 00 00 00 00 00_{16}. After bit stuffing this results in the following bit pattern:

1000001110000010000010000010000010000010000010
00001000001000001000001000001000001

The underlined bits are the DLC field and those in bold are stuff bits. The others are the payload bits in the 8-byte CAN data field. The digital signal to the CAN transceiver (i.e. the TX pin from a CAN controller) is shown in Figure 1.

In a carrier frame are fourteen intervals of five dominant bits (i.e. 00000) followed by a recessive bit. The proposed CAN-HG protocol adds short-duration bits – called Fast Bits – within these intervals. The Fast Bits are placed so that all CAN controllers receiving the frame (including the transmitter) see only the original signal. This is ▷

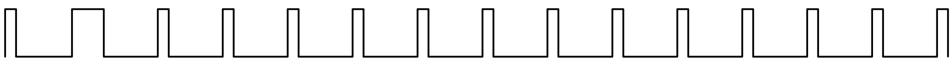

Figure 1: Carrier frame signals at the TX pin (Photo: Canis)

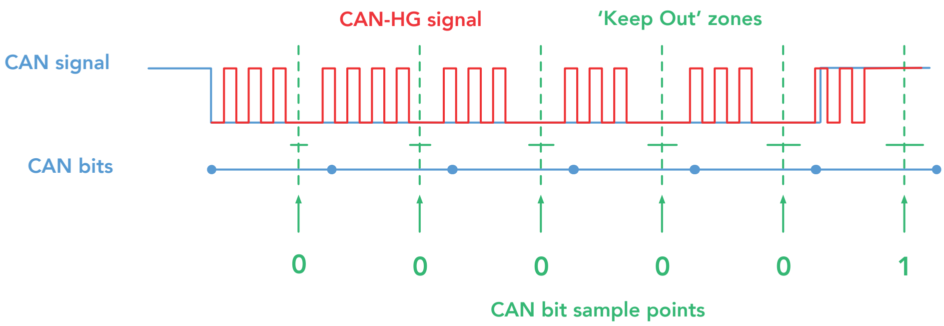

Figure 2: A 6-bit CAN interval beginning with a falling edge, recessive-to-dominant (Photo: Canis)

Reserved (32 bits)	Payload (Fixed number of bytes)	CRC (24 bits)

Figure 3: CAN-HG frame format with Reserved, Payload, and CRC field (Photo: Canis)

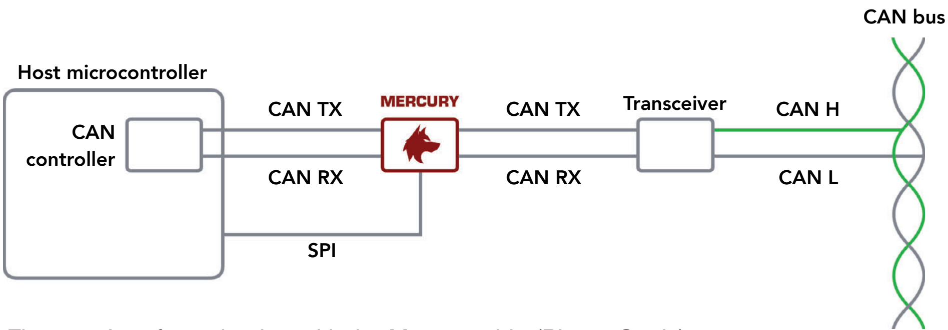

Figure 4: Interface circuitry with the Mercury chip (Photo: Canis)

illustrated with a simplified example in Figure 2. It shows a 6-bit interval beginning with a falling edge from a recessive bit (i.e. 1) and ending at the end of the final recessive bit, with the vertical arrows showing the sample points for each bit. The fast bits overwrite the original CAN signal but return to the original signal value around the sample point.

In ordinary circumstances it would not be possible to put arbitrary edges within a CAN bit: a falling edge initiates the re-synchronization process, which adjusts the sample point and this would then cause later bits to be misread, leading to a CAN error frame being raised and a failed frame transmission. But with CAN-HG the format of the carrier frame and the placement of fast bits are designed to exploit a feature of the re-synchronization: the first falling edge at the beginning of the interval is a re-synchronization point. All connected CAN controllers will perform sample point adjustments to offset from when this edge is detected. But further falling edges within the same bit (up to the sample point) will not result in another re-synchronization: this is prohibited by the Classical CAN protocol. Furthermore, falling edges after the first sample point and in subsequent bits in the interval (up until the sample point of the last bit in the interval) will also not result in a re-synchronization: the Classical CAN protocol prohibits this, if the previously sampled bit is dominant.

The first Fast Bit in an interval is placed a suitable time after the falling edge marking the start of the first bit in the interval. The delay is long enough to give all controllers time to have detected the edge because the CAN controller state machine polls for the falling edge with its time quantum clock. Fast Bits are not located within a Keep Out zone around the sampling point to ensure that all connected CAN controllers see the original signal. The zone is large enough to encapsulate the earliest possible time any CAN controller could sample the bit to the latest possible time. This must account for jitter due to the time quantum polling period: the re-synchronization point – and therefore the sampling points – will vary relative to the falling edge at the start of the interval. It must also account for the different nominal sample points of each CAN controller: they typically will be clocked at different frequencies and have a different number of time quanta per bit.

The zone must also allow for the effects of clock drift in the oscillators of each CAN controller. CAN-HG allows each of the six Keep Out zones to be of a different duration to account for clock drift: for the first zone the clocks can have drifted only a small amount but by the last zone the clocks may have drifted by a significant amount. This is to allow more Fast Bits to be placed in the interval.

2.4 Encoding fast bits

Fast Bits are encoded with a simple NRZ asynchronous serial communication scheme. The falling edge at the start of the interval is taken as the end of a stop bit and used as a synchronization point and the first Fast Bit is located a fixed time offset from this point. The last Fast Bit before each of the first five Keep Out zones is designated a stop bit (and hence is always a logic 1) and the falling edge of this bit is used to resynchronize the fast bit timing.

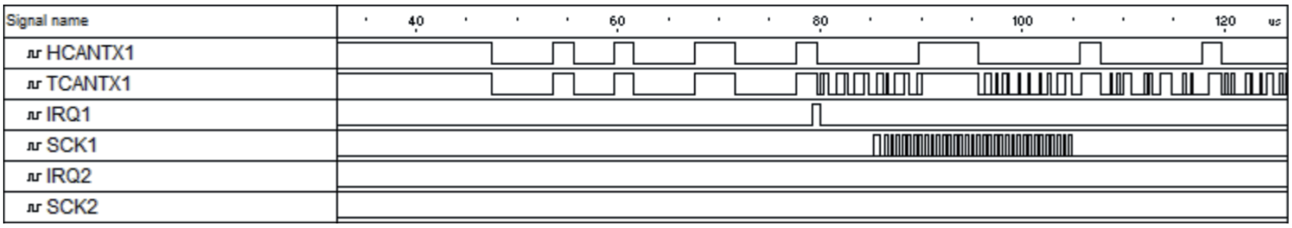

Figure 5: Logic analyzer trace of the first part of a CAN carrier frame (Photo: Canis)

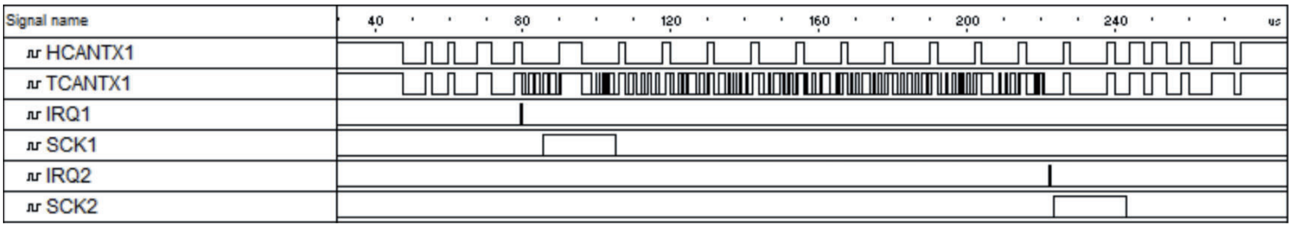

Figure 6: Logic analyzer trace of a received CAN-HG frame (Photo: Canis)

CAN-HG also supports bit stretching: it allows the duration of a Fast Bit to vary based on the time since the last stop bit falling edge so that bits closer to the sync point can take advantage of the lower clock drift and be shorter than ones further away. This can significantly increase the size of the overall frame payload.

The following Fast Bit parameter settings configure the CAN-HG network:

- The skip times from the falling edge of a stop bit (or the start of the interval) to a Fast Bit
- The number of subsequent Fast Bits (including a subsequent stop bit)
- The initial duration of the first Fast Bit after a stop bit
- The bit stretching factor to add to the duration of each subsequent Fast Bit
- The offset to Fast Bit sampling to compensate for the additional CAN transceiver dominant-recessive propagation delay
- The total number CAN-HG payload bytes (all CAN-HG frames within a network have the same fixed payload size)

A set of CAN-HG Fast Bit parameters can be checked for validity against a given set of network properties (oscillator accuracy, CAN sample point ranges, etc.). It is a simple search problem to find a set of parameters that pass the validity checks. Payloads of 120 bytes are achievable for common network properties.

A CAN-HG frame has the following format: All fields are an 8-bit multiple and are fixed in size. The Reserved field has a fixed length of 32 bit. It is reserved for future usage (it is intended that it will contain sequence number and timestamp information generated automatically by the CAN-HG hardware). The Payload field is of fixed but configurable size, depending on the parameters set for the network (as described above).

The CRC field has a length of 24 bit, with a polynomial of $5D6DCB_{16}$ and an initial value of $FEDCBA_{16}$ (the same as the Flexray CRC), which gives a Hamming Distance of 6 for frames up to 2024 bit. The CRC is calculated over the CAN-ID of the carrier frame and the Reserved and Payload fields of the CAN-HG frame. There is a long-standing problem where the CRC of CAN has a Hamming Distance of just 2 in certain pathological cases due to stuff bits. This is addressed in CAN-HG: the checking in CAN-HG not only checks the CRC-24 but also checks that the carrier frame is of the required fixed format. Early computational experiments suggest that a carrier frame consequently has an effective Hamming Distance of 7. A CAN-HG error is handled in the same way as for the CAN protocol: an error frame is generated that destroys the carrier frame and triggers the normal CAN error recovery process.

Guarding the network

There are two major properties of any secure messaging scheme:

- Authenticity: To act on the contents of a frame, the receiver must be sure the frame came from the genuine sender.
- Secrecy: The contents of the frame must be kept secret and shared only with the intended recipients.

Authenticity is important because it allows a system to be built in which each node can trust the contents of the frames and does not have to construct elaborate (and potentially faulty) protocols for checking the data. Secrecy is also useful, not just for protecting sensitive data (perhaps the firmware of a node during download) but also because it makes it harder to reverse engineer or tamper with a system.

A common way to obtain authenticity and secrecy is with cryptographic protocols. But there are significant costs to this: there is the complexity and overheads within each node of including cryptographic protocols (code space, RAM, CPU time), the overheads on the bus (extra data needs to be sent to authenticate frames and to prevent replay attacks and there are synchronization delays that add to latencies) and the challenge of distributing and storing secret keys in every node.

CAN-HG provides in hardware both frame authenticity (for CAN frames as well as CAN-HG frames) and frame secrecy.

CAN-HG provides frame authentication by means of anti-spoofing: preventing spoofed frames from reaching nodes. The anti-spoofing features apply at the CAN level: all CAN frames are protected, not just CAN-HG frames. ▷

The core concept of CAN-HG bus guarding is the authorized frames list: it is a secure list inside the CAN-HG hardware that lists the CAN frames that the host node is authorized to send and the CAN-HG frames that the host node is authorized to receive.

An outgoing CAN frame from the host node is checked against the list and if it is not on the list of transmitted CAN frames then the frame is blocked from transmission. This ensures that if any node with CAN-HG hardware is hijacked it cannot send spoofed CAN frames on the bus.

An incoming CAN frame to the host node is checked against the list and if it is on the list of transmitted CAN frames then the CAN-HG hardware destroys the CAN frame. A frame is destroyed in the same way as for a faulty CAN-HG frame or carrier frame: an error frame is generated that destroys the frame and triggers the normal CAN error recovery process. This ensures that all nodes that normally receive this frame from the host node are protected against spoofing of that frame. The above means that CAN-HG provides protection to CAN nodes that don't include CAN-HG hardware.

CAN-HG supports secrecy for CAN-HG frames. The authorized frames list has entries for the identifiers of carrier frames containing CAN-HG payloads that the host node can receive. A CAN-HG frame payload is only decoded and passed to the host node if the incoming frame appears on this list. Unauthorized nodes – including those without CAN-HG hardware – will see only the carrier frame.

The first CAN-HG circuitry

The Mercury chip by Canis is a small stand-alone integrated circuit that is placed between the micro-controller with on-chip CAN module and the CAN transceiver. The first demonstrator system built by Canis uses the STM32F405 micro-controller by ST-Microelectronics, which comprises a bxCAN module. The CAN TX and CAN RX pins are routed into the Mercury chip, which modifies the bus signals and input those into the CAN transceiver. By default the CAN TX signal from the micro-controller is reflected to the transceiver, and the CAN RX signal from the transceiver is reflected to the micro-controller.

The Mercury chip is interfaced to the micro-controller via SPI as an SPI slave. As well as the four SPI lines (SS, SCK, MOSI, MISO) it includes an interrupt line to request servicing from the micro-controller. The SPI commands are structured so that most of the handling of SPI can be done by DMA in the micro-controller. The Mercury chip does not contain a complete CAN controller: all CAN frame handling is done by the CAN module in the micro-controller, including the generation of carrier frames. The Mercury chip contains a CAN receive state machine that is used to drive the CAN-HG protocol.

When the micro-controller sends a CAN frame this is detected by the Mercury chip and when the ID part has been received it is matched against the authorized frames list (by applying the mask and must-match values for each member of the list). If none of the entries match then the frame is being transmitted illegally and is destroyed: by pulling the TX line to the transceiver to dominant for six CAN bit times ▷

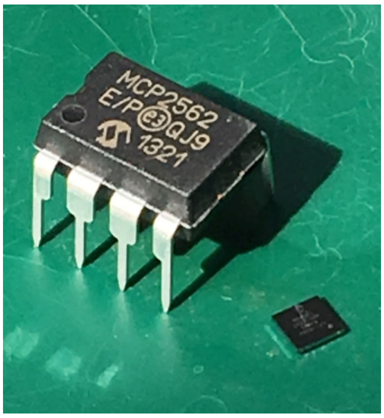

Figure 7: The Mercury chip is on the right; the chip on the left is a CAN transceiver (Photo: Canis)

(this is a CAN error flag and causes the frame to be abandoned and arbitration to be restarted in accordance with the Classical CAN protocol).

If there is a match in the authorized frames list and the frame is marked as carrier frame then the Mercury chip raises an interrupt to request that the micro-controller supplies the CAN-HG payload data for the carrier frame. The micro-controller queries over SPI the identity of the carrier frame and the Mercury chip returns a 6-bit index into the authorized frames list to indicate which frame matched. From this, the micro-controller can determine the CAN-HG payload and push it over SPI. The Mercury chip injects the payload data into the CAN-HG Fast Bits stream in the carrier frame as it continues to be transmitted by the micro-controller.

The logic analyzer trace in Figure 3 illustrates this for a carrier CAN frame with an 11-bit ID of 123_{16}. The signal HCANTX1 is the CAN TX signal from the micro-controller, TCANTX1 is the signal from the Mercury chip to the CAN transceiver, IRQ1 is the interrupt line from the Mercury chip to the micro-controller and SCK1 is the SPI clock from the micro-controller (the SPI master). The trace shows how the interrupt is generated after the ID field and how the Mercury chip sends the Fast Bits representing the Reserved field while the micro-controller engages in an SPI transaction to push payload data (the SCK1 signal shows SPI activity).

Incoming CAN frames are handled as normal by the on-chip CAN module in the micro-controller: the CAN RX signal is passed through the Mercury chip from the CAN transceiver. The ID of the CAN frame is checked against the authorized frames list and if the frame is being received, but matches against a transmitted frame in the list, then the frame is destroyed by the Mercury chip. An incoming frame that matches against an entry in the list that marks it as a carrier frame triggers the CAN-HG frame reception process: the Fast Bits are decoded and the Reserved field is stored, the payload is placed in an internal buffer and the CAN-HG CRC checked. If the CRC does not match or the incoming frame is not a well-formed carrier frame (i.e. is not 8 byte or does not have a payload of 30 00 00 00 00 00 00 00_{16}), then the frame is assumed to be corrupted and is destroyed. If a CAN-HG frame is received correctly then an interrupt is raised and the micro-controller extracts the payload over SPI. The CAN-HG payload is provisional: it must be tied back to the reception of the carrier frame. If the payload is received before the carrier frame completes it is possible that an error subsequently occurs before the carrier frame is received and the frame is destroyed and retransmitted according to the CAN protocol. The micro-controller CAN-HG driver marks the payload as received only when the corresponding carrier frame has been received.

The logic analyzer trace in Figure 4 illustrates the reception of a CAN-HG frame. The signal IRQ2 is the interrupt line at the receiver and SCK2 is the SPI master clock at the receiver. The trace shows how the CAN-HG payload is received before the carrier frame. With the specific network parameters in the example the CAN-HG frame fits into the first thirteen carrier frame intervals and the last interval is not used. The carrier frame is received some time after the CAN-HG frame is received and its payload uploaded to the micro-controller over SPI.

The shown Revision A version of the Mercury chip comes in a 36-pin BGA package.

The Mercury chip supports an authorized frames list of 64 entries with match/don't care masking over CAN IDs. The SPI interface can be clocked at up to 20 MHz. The CAN-HG payload size is fixed at 32 byte. Future revisions to the silicon are planned, including performance and security enhancements. For high-volume applications the Mercury functionality could be integrated into a CAN transceiver package or a micro-controller.

Deployment

CAN-HG was designed to make deployment easy and CAN and CAN-HG traffic can be freely mixed on the bus and so the deployment of CAN-HG can be focused on where it matters most. This means there is no need to update the hardware and software across all nodes on a network. Depending on the threat model for a network only a subset of nodes needs CAN-HG hardware: only frames that need protection from spoofing need hardware to enforce it. And the performance benefits of CAN-HG can be applied first in only the nodes with the highest bandwidth demands. An existing network design needs only minimal changes to obtain security and performance benefits of CAN-HG.

Mercury was designed to make the adoption of CAN-HG even easier: it does not require changes to micro-controller hardware or CAN controller software. A node can continue to use the same silicon and the same software drivers and continue to exploit the specific features of a specific CAN controller (for example, making use of hardware support for Time-Triggered CAN). If a node requires just the security features of CAN-HG, then there are no software changes required: a configured Mercury will destroy spoofed frames without any intervention by the micro-controller. And the higher performance of CAN-HG can be obtained just by adding Mercury SPI drivers. ◀

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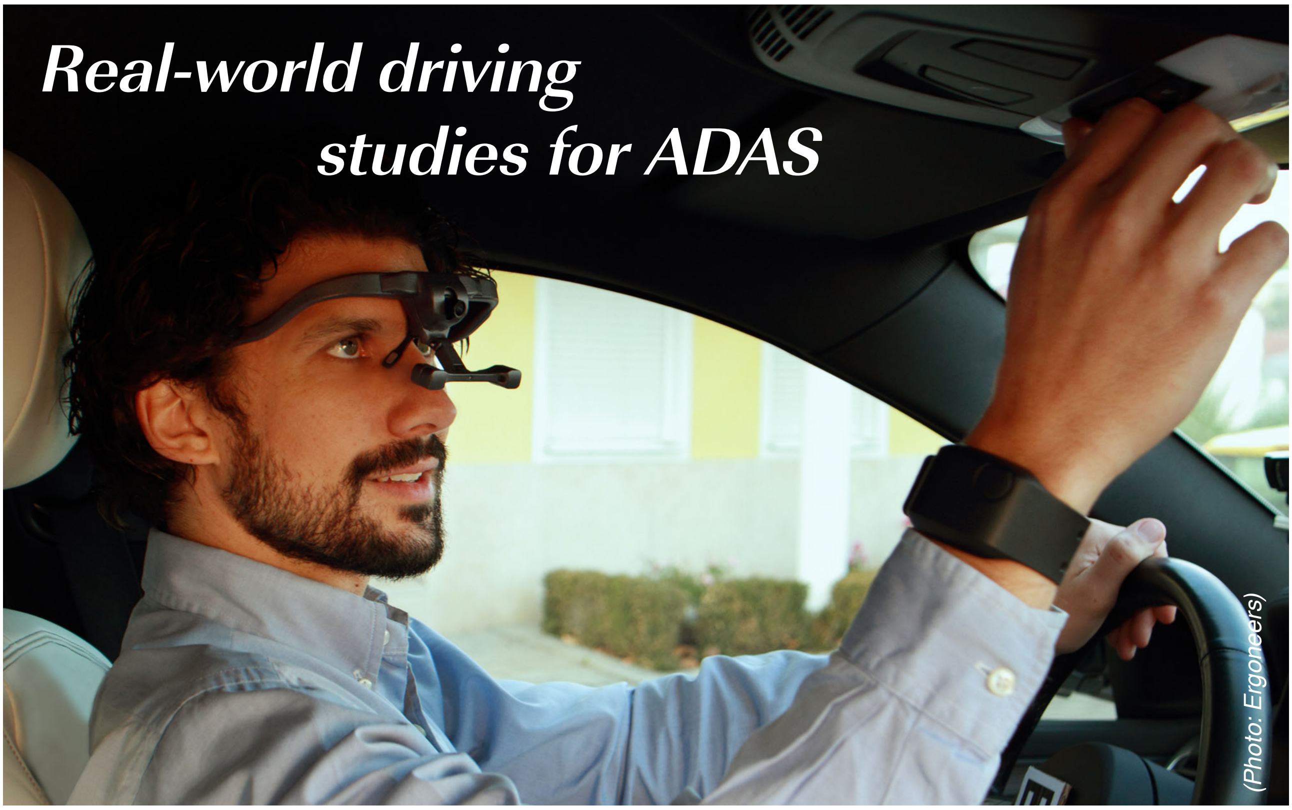

Real-world driving studies for ADAS

No doubt ADAS testing is important. But simulation only is not sufficient, real-world driving studies complement them.

The range of ADAS (advanced driver assistance systems) is growing – and not just since connected cars and autonomous driving has come increasingly to the fore of the automotive industry. Using sensors, ADAS detect the vehicle environment, interpret these, and aim to support drivers while traveling as well as improve driving comfort. Because ADAS (still) do not independently contribute to vehicle safety, it is particularly important that they do not jeopardize the safety of the driver by distracting or disrupting them. Before such systems are adopted in the vehicles, they should be tested under conditions that are as realistic as possible.

For several years now, renowned automakers have already been testing their ADAS using behavioral observation – before their products are launched. Frequently, a simulator is used to carry out such behavioral observations. A simulator provides most characteristics of an auto cockpit, such as a dashboard with a steering wheel, and it has high validity because experimental scenarios can be repeated on a 1:1 basis, delivering good possibilities of comparison. However, these results can only be transferred to the real world in a limited way, as the driver environment is only displayed on one screen. These limitations include in particular the driving dynamics, because driving characteristics and the driving impression in the simulated world does not correspond to those in the real world, and thus, the actual reaction of the driver may differ under certain conditions. A useful addition to the simulation studies is therefore so-called real-world driving studies, which present a method for driver behavioral observation in a real-world driving environment. In doing so, drivers sit in a real car and are on the road in everyday traffic. Their behavior during the journey is monitored by experts as well as specialized technology, which records and analyzes interaction between the driver and ADAS.

Ergoneers specializes in the development of hardware and software for behavioral research. The company has therefore developed the Vehicle Testing Kit (VTK), which features several hardware components and provides the modular D-Lab software platform to facilitate the execution of real-world driving studies. This specially designed tool minimizes work during real-world vehicle studies: So far, an enormous effort has been required in terms of technology, time and thus finances, to install the entire test equipment for test series in a suitable vehicle. VTK provides a cost-effective solution: It is portable, easy to manage, and can be integrated effectively into various vehicles. Data are then structured and systematically collected, and can then be evaluated from ▷

Figure 1: The VTK comprises several hardware components and the D-Lab software platform (Photo: Ergoneers)

▷

Figure 2: The VTK is put on the back-seats and linked to the CAN-based in-vehicle networks (Photo: Ergoneers)

various perspectives using the measuring and analysis software D-Lab.

Eye-tracking glasses, such as the Dikablis Glasses by Ergoneers, allow logging and retracind, when and where the gaze of the driver is directed while testing an ADAS. The retention time of the gaze at the system plays an important role here: Looking at the system – and thus not on road traffic – can compromise the safety of the driver as well as others in road traffic. For comprehensive data collection, audio and video data can also be used, leading to an even more precise measurement of the interaction between driver and ADAS. By also reading the CAN frames and interpret them. This important data of the vehicle itself can also be retrieved – in addition to driver information. In this way, it is possible to retrace when, for example, the car braked and how often the driver manually operated the assistance system.

However, collecting these data is not enough. In order to save valuable time, the exact evaluation is automated using the measuring and analysis software D-Lab; in this way, the variables can be defined flexibly yet comprehensively. Furthermore, using the marker technology developed by Ergoneers, the eye tracking data can be completed in a fully automated manner. In conjunction with the data from the CAN network, it is now possible to retrace very accurately why a driver braked or which system elements have induced any overly-long retention time during use. In this way, the operation of the elements is adapted so that the driver looks less at the system, allowing for more time for road traffic.

Testing such systems in advance constitutes an important point in the product cycle. In doing so, it can be guaranteed that ADAS support drivers and avoid putting them in danger. ADAS are particularly important for the drivers of the future; they are a stepping stone towards autonomous driving. ◀

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Electricity in the blood

A small device with a big impact: The IVT current measuring technique from Isabellenhuette can even be found in racing cars today.

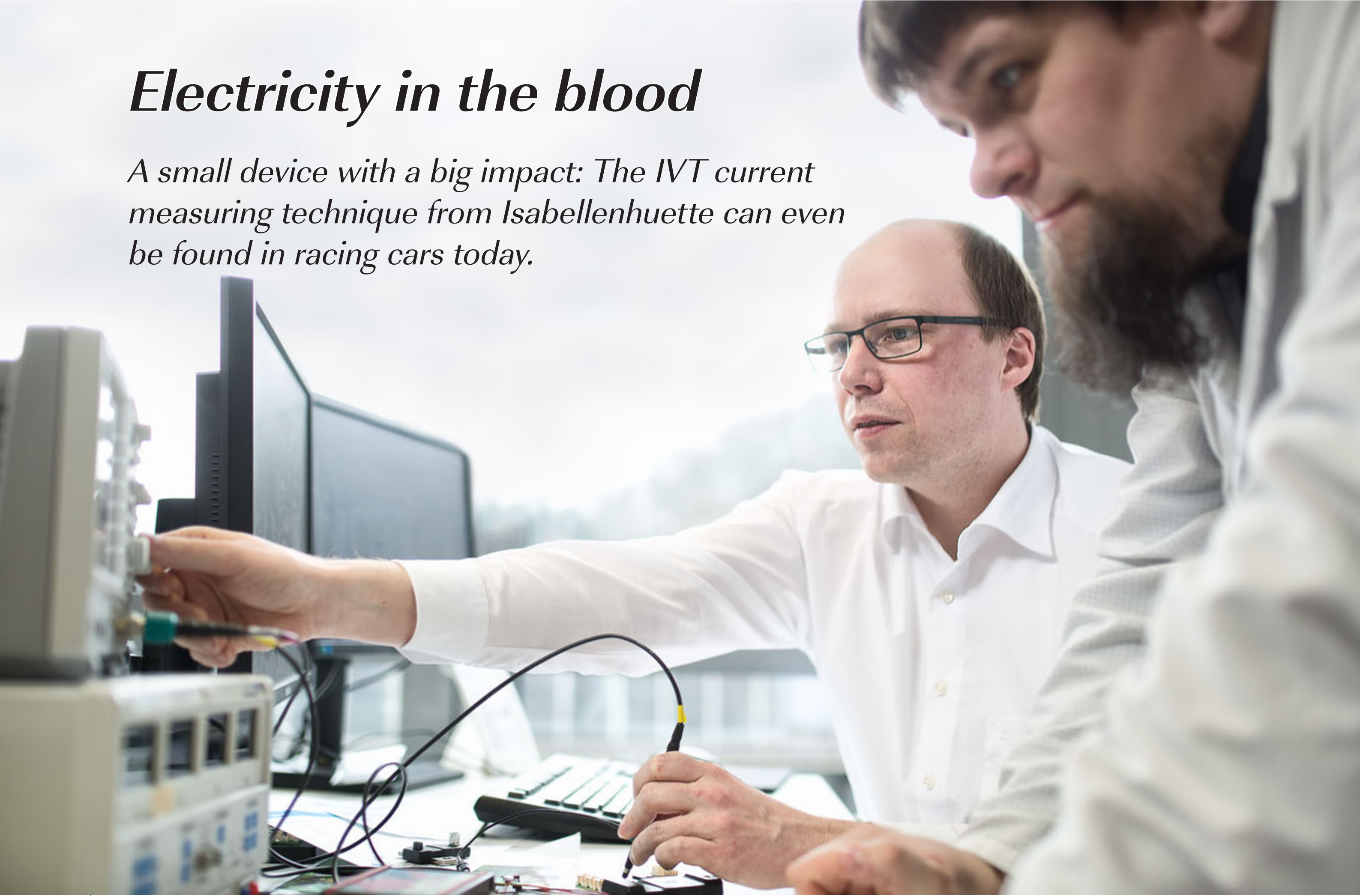

Figure 1: Andreas Lepper (left) and Florian Simon test the IVT-F measurement system for Formula E (Photo: Isabellenhuette)

Largely unnoticed by the public, the family-run company from Dillenburg in Hesse has become an FIA (Fédération Internationale de l'Automobile) partner in recent years. It is a commitment from which Isabellenhuette has already gained valuable insights in Formula One for the mass production of precision measurement systems. They have now been doing this in the high-performance environment of Formula E since 2014 as well.

Andreas Lepper, the project manager of the IVT-F development team at Isabellenhuette, coordinates the cooperation with the FIA. "The cooperation essentially began almost 10 years ago," said the 37-year old electrical engineer. "That is when the McLaren Formula One team approached us. At the time, the McLaren location in Woking, England was looking for a current sensor for the first hybrid system to be used in a Formula One racing car."

Motorsports fans know this system under the name Kers (kinetic recovery system). A look back: The Formula One team McLaren gained an advantage already in 1998 by using the energy recovery system, but just for a single race and then it was banned again. "As we know today, however, that was not the end of Kers." For commercial and environmental reasons, the concept of the energy recovery system ultimately made sense. That is why there would be another Kers revival 10 years later. And again it was McLaren who advanced this new technique. "At the time, we were working together with a British company that specialized in prototype design and that provided the measurement technique for this purpose. McLaren also relied on its services. And that is how the first contact came about," explained Lepper.

And like in a déjà vu, McLaren also left the competition in the dust in 2009 by using the Kers again. "This was an achievement of the IVT measurement technique," explained Lepper. The other teams were less excited about it. The result: In a gentlemen's agreement, the team bosses agreed to no longer use Kers. It was first in 2011 that the FIA officially allowed the use of Kers. In 2014, it was ultimately replaced with ERS (energy recovery system). The advanced energy recovery system now not only converted braking power into energy, but also extracted additional power from the exhaust fumes.

IVT measurement technique comes into play

To ensure that no team could gain an advantage, the FIA required a complete and transparent data collection of the amount of energy that flows into the drive train as soon as the driver activates the ERS. Since then, energy volumes and opening times of the ERS window have been detected, recorded and issued by the IVT measurement technique in Formula One.

"During this time, we have constantly continued to develop the IVT measurement technique and have specifically designed it to meet the requirements of Formula One racing," explains Lepper. When Formula E finally starts racing in 2014, Isabellenhuette's measurement technique also experiences a tremendous development boost. The ▷

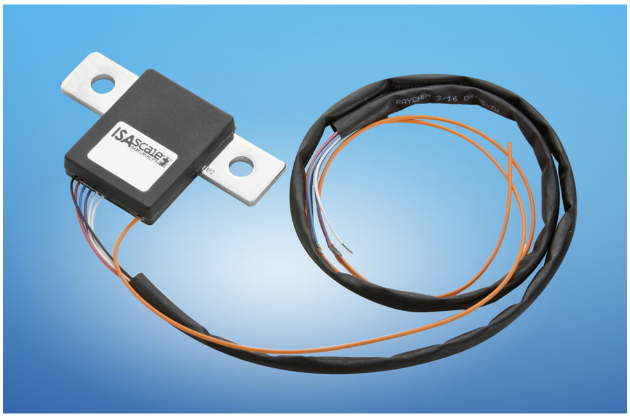

Figure 2: A small device with a big impact: After Formula One, Isabellenhuette has also been equipping all Formula E racing cars with the IVT-F current measuring system since 2014 (Photo: Isabellenhuette)

invariably battery-powered racing cars place entirely new technical and physical requirements on the measurement technique. The sensor must then be enhanced again in terms of precision, performance, and compactness. The experience gained from Formula One was helpful here. The latest result of this development work is the IVT-F (F for Formula). This special design has been used in all Formula E cars since 2014.

Working for the FIA above all means working under pressure. Within a development period of just a few weeks, the engineers of Isabellenhuette design a completely new measurement system – including the design, prototyping, tests, and production. This requires a high level of expertise and lots of development power. "We are in close contact with the FIA engineers in Geneva. That is where the requirements for the performance profile and design come from.” Adjustments are allowed, are carried out by the team, and then approved by the FIA. That’s what the rules stipulate. “Of course we provide support here with the optimal system integration, on the hardware side, for example, through structural variations in the size and installation position, and on the software side through dbc-file or support with the implementation of the communication via CAN.” This will also be this way in the coming season when the cars will be even more powerful. It changes a lot. For Isabellenhuette too. However, Lepper is sure: “The fifth generation IVT-F will also master these challenges.”

IVT-F – “Mr. 1000 Volt” among measurement systems

The currently installed shunt-based measurement systems of the fourth generation are characterized by extreme precision and insulation strength. In order to achieve similar speeds in the racing cars as Formula One combustion engine cars, power is required that can immediately be accessed as efficiently as possible within specified limits in a corresponding amount and voltage. First and foremost this affects the so-called Fan-Boost. Here drivers selected by the fans get additional energy packages. They help achieve an additional performance boost during the race. The IVT-F is responsible for precisely measuring these processes and ensuring fair competition.

The Isabellenhuette team developed a new type of isolation for this purpose, which is now even used in large-scale products, such as the IVT-S. It is at 1000 V and uses the isolation properties of the printed circuit board itself in order to achieve the insulation strength required in the Formula vehicles. This is quite an impressive maximum value. Because: “To the best of my knowledge, there is no competitive product that has such a power capacity coupled with an ultra-compact design,” states Lepper. In addition, it comes with very good linearity, tailor-made electronics, quick scanning, and in-house calibration, which lead to the measurement precision of the IVT-F. And measurement precision is indispensable in Formula E in particular, because, among other things, it provides exact information about power consumption and voltage – key values that are decisive for the race.

Of course there is a very specific interest behind the Formula E commitment. Like any technique partner, Isabellenhuette strives to gain insight that its series production will benefit from. Isabellenhuette utilizes Formula E for this purpose. On the one hand, it strives to constantly demonstrate expertise and capability in a very dynamic environment, but on the other hand it strives to ensure a constant flow of expertise that the company wants to use to further expand its leadership within precision measurement techniques. “We expose our system to the harshest conditions in Formula E. In this way, we gain valuable insights that ultimately have a positive impact on the quality, performance and design of our IVT series products,” confirms Athier Lafta, product manager for precision measurement techniques at Isabellenhuette. And it's worth it. The IVT-MOD has already benefited from detailed technological solutions that first had to prove themselves in Formula One before going into series production. This in turn led to the development of the successor IVT-S.

According to Lafta, it is clear that the requirements in the automobile manufacturer market will also continue to increase in terms of e-mobility and continuously improved products will be demanded, for example modules with a higher system voltage. "And Isabellenhuette can deliver these products already today, thanks to Formula racing." ◀

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Helping to pave the future

Replacing analog circuitry by CAN-connectable devices in pavers provided more benefits than adding of displays.

(Photo: HED/Carlson)

The Pacific Northwest of U.S.A. is known for its rainy climate, and the infamous weather brought Carlson and HED together. Carlson was looking for an electronics solution to solve water ingress problems. Kevin Comer, Carlson's Engineer Manager, saw HED's demonstration of a working display module submerged in water at Conexpo, and encouraged his engineering staff to reach out. After success with a display project, Carlson and HED started to work together, most recently on Carlson's CP-100 and the CP-130.

The CP-100 and CP-130 are commercial class pavers that feature more options than many other machines in their class. They both utilize fully electronic controls with custom legend rocker switches and twin 7-inch color touch displays for operator input. While the most commonly used functions have switches available, almost every function of the machine is accessible through the graphical user interface on the displays.

The CAN controller and software by HED replace the CP-100's original analog circuitry and mechanical engine control. This upgrade provided benefits beyond the addition of the displays. It accommodated the increased needs of the engine control, provided more accurate control over several key functions, and eliminated time consuming calibration procedures from the traction control and steering. EPA Tier 4 legislation requires much more stringent control over the exhaust gas emissions. To accomplish this, additional components, including various actuators and sensing are required. The CAN-based controller allows Carlson to interface with the factory control system for the engine via the CAN-based SAE J1939 network. Carlson chose this avenue over the much more costly option of having a custom engine calibration created to operate with the previous analog circuitry.

The previous CP-100 system required numerous discrete components that increased failure risks. All of the wiring had to be duplicated on both sides of the machine and joined in a central control box, while avoiding backfeeds and short circuits. The (new system) eliminated redundancies, requiring only a few switches while the software does the rest. Adding auger control functionality eliminated a previous controller that costs U.S.-$ 2000 per machine. This savings alone justified the cost of purchasing the controllers. Streamlining controllers reduced the number of harnesses and connections for less failure points. The paver went from up to eight harnesses spanning the entirety of each machine down to four dedicated ones.

Not only does the controller communicate with the engine itself, it also lets mechanics connect to system diagnostics with the Conductor software. This makes troubleshooting easier and reduces time for service calls by allowing the technician to view the status of every aspect of the control system from a single concise screen.

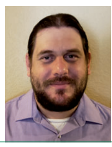
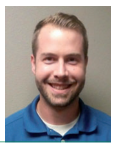
By upgrading to an electronic control system using CAN networks, Carlson is staying on pace with industry trends. Furthermore, the upgrades eliminate the need for calibrating the steering control, which saves a minimum of two hours of calibration time per machine, and makes the process more exact. ▷

"Reduction of hours for calibrations increases our shop throughput, which in turn increases how much product we can produce," said Kevin Comer. With a high production rate of machines released per month and ever rising demand for the product, the calibration hours could balloon. The electric steering control prevents that, as the software does its own calibration.

HED understands that a company can have the best technology in the world, but it won't matter if people don't want to use it. That's why HED and Carlson made improving user experience a central goal of the CP-100. By replacing toggle switches and decals on metal plates with 7-inch touch screen displays, improving the accuracy of controls, and simplifying the diagnostic process, HED improved functionality for Carlson's customer.

The CP-100 is far from the end of the HED-Carlson partnership. In the future, the next project is to install on-board telematics onto Carlson's pavers. As with the streamlined CAN controller, adding on-board telematics would have multiple benefits. First, it will help equipment owners understand where each asset is at any time, what it's doing, and how it's being used. Second, HED's remote diagnostics and over-the-air programming (OTAP) telematics will make service calls easier for Carlson's dedicated staff of technicians. Whereas service calls previously required multiple days of travel to customer sites for a diagnosis, a Carlson service tech can solve the problem quickly using HED's remote diagnostics and back office portal tools, reducing the need for a trip to the customer. The OTAP tools facilitate remote software updates, eliminating the need to send modules back and forth.

The final touch that made the CP-100 project successful is HED's approach to system development with their customers. HED incorporates a customer-focused, partnership approach to each project. HED application engineers worked side by side with Carlson's system engineers to define, develop, prototype, troubleshoot, and document the new system. This collaboration streamlines development times, unifies project expectations, and results in the giving the customer an optimized vehicle control solution. Comer reflects that "Carlson and HED has been a good team together developing this platform of products. We look forward to doing future projects and using HED components in the future." ◀

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CiA 320

CANopen specification for sleep and wake-up handling

Switching-off and switching-on CANopen devices is especially in battery-powered systems important. CiA 320 describes services and protocols to do so.

CANopen devices, which support low-power modes, can be set to a mode of reduced energy consumption by means of the CiA 320 services and protocols. The specification supports also CAN transceiver chips providing low-power mode or selective wake-up functionality as standardized in the ISO 11898 series.

CANopen sleep and wake-up handling are implemented for example in light electric vehicles, add-on modules for special-purpose cars, service robots, or any other application that operate on a limited amount of energy, and in which energy management is therefore essential.

The CiA 320 services enable the power management master (PM master), which is residing at the active CANopen NMT master, to control the local Sleep finite state automaton (FSA) and the remote Sleep FSA of all power management devices (PM devices) in the network. The PM master protocol uses messages mapped to CAN data frames in classical base frame format (CBFF) with the CAN-ID 691_h to send commands to PM devices. PM devices respond with messages mapped to CBFF with the CAN-ID 690_h, or the EMCY write protocol as specified in CiA 301 to transmit requests to the PM master. Good to know: The CANopen parameter $117F_h$ provides information about the reason for CANopen devices to stay awake or to request sleep.

Finite state automaton (FSA)

For power management purposes, the Sleep FSA as specified in Figure 1 shall be implemented for sleep and wake-up handling. This FSA specifies the behavior of a PM device, from an operating mode with full energy consumption to an operating mode with reduced energy consumption. The definition of any relationship between an application-specific FSA such as e.g. given in CANopen device profiles and CANopen application profiles, and the Sleep FSA is not in the scope of CiA 320. The FSA shall support the Sleep FSA state transitions as given in the specification.

Services and protocol specification

There is a range of services required for the sleep and wake-up handling, which is specified in the CiA 320 document. These services include query sleep objection, sleep objection and set sleep, set alive, wake-up of PM device, wake-up of PM master, and request sleep. Furthermore, the CiA 320 services allow an automatic transition to Sleep state of a PM device, in case there are no live-signs of the PM master.

The protocols specified in CiA 320 implement these quoted services. They exchange messages between the PM master and the PM device(s). As already mentioned in the beginning of the article, the PM master uses CAN data frames with the CAN-ID 691_h. The PM device uses CAN data frames with the CAN-ID 690_h, or Emcy write protocol as specified in CiA 301.

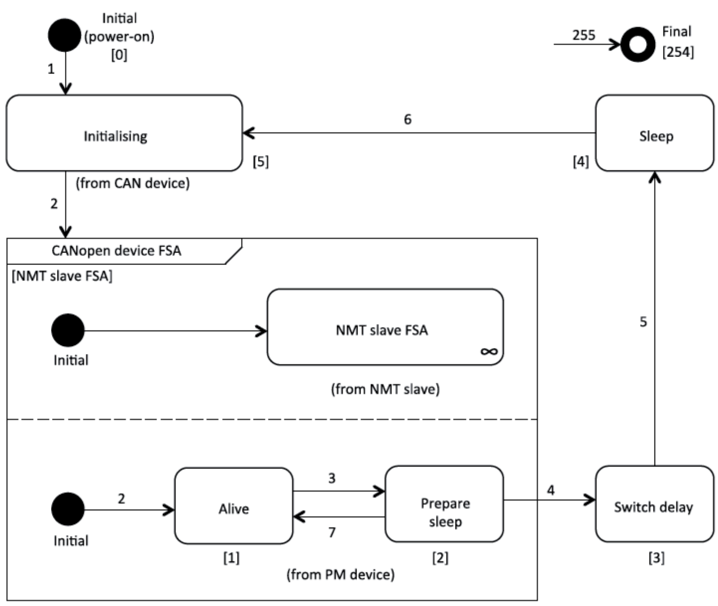

Figure 1: Sleep FSA (Photo: CiA)

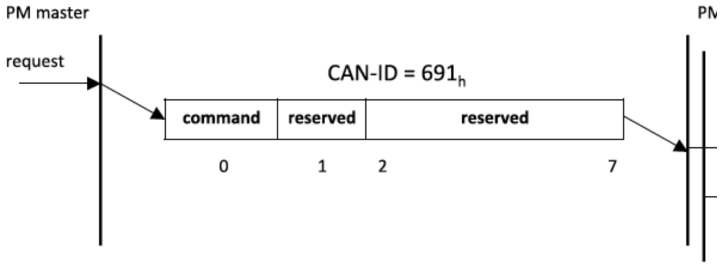

Figure 2: The Query sleep objection protocol as specified in this figure and Table 1 shall be used to implement the service query sleep objection (Photo: CiA)

Table 1: Value definition for query sleep objection

Field	Data type	Value	Description
command	UNSIGNED8	01_h	Command specifier for "query sleep objection" service
		00_h; 02_h to FF_h	Reserved by CiA
reserved	Reserved by CiA, always 0.		

Error and diagnostic handling

CANopen devices compliant to CiA 320 shall support the service Emcy write service, as specified in CiA 301. This service is triggered by internal errors in the CANopen device. In addition to the emergency error codes (EEC) given also in CiA 301, a PM device compliant to CiA 320 supports additional emergency error codes.

Battery-powered CANopen devices, for example in Pedelecs (CiA 454) or in special-purpose cars (CiA 447), need such sleep and wake-up functionality, in order to reduce power consumption during longer standstills. The same applies for battery-powered service robots and automated-guided vehicles with embedded CANopen networks.

"Up to now, all those sleep and wake-up-capable CANopen devices used proprietary protocols," explained Holger Zeltwanger, former CAN in Automation Managing Director. "The release of CiA 320 unburdens system designers to invent on the application level sleep and wake-up functionality." Now, they can buy interoperable products providing sleep and wake-up capability. ◀

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(Photo: Miunske)

Customized CAN-connectable electronics

What have a fire-patrol vehicle in the Netherlands, a windrow turner in France, and an ambulance in Poland in common? In the first glance, it is not much. But the central electrics come from Grosspostwitz nearby Bautzen in Saxony (Germany).

Modern vehicles and machines need a solid power supply, specifically designed in shape of a vehicle power electrics/electronics. Anyway, vehicle manufacturers most likely reduce the number of suppliers constantly and source hardware, development work, and programming out of one hand at best. Johannes J. Miunske, who did found his company in 1996, now with 70 employees, is exactly working towards that goal. It began with trading of electric vehicle components. Pretty soon customer's desires led to services like the completion of assembled units. Smaller services led to developments of more complex systems, the assortment was steadily growing. Miunske finally kept the distribution of at least eight renowned partners but, the development of complex systems and components for trucks, special vehicles and mobile machines grew up to a solid second column.

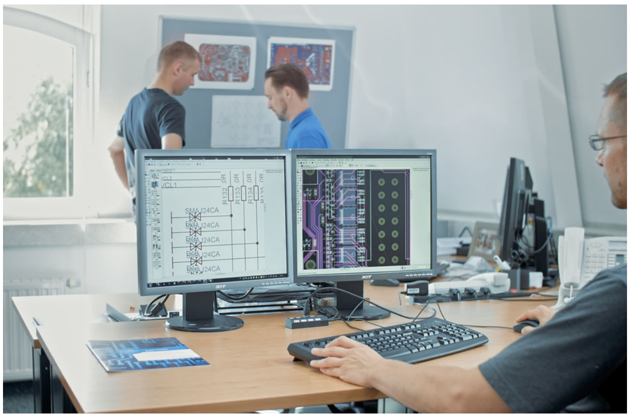

Figure 1: Developer place in the electronics development; the conception of the PCB's begins if all functions are guaranteed (Photo: Miunske)

The smart central electronics in a vehicle is the centerpiece for communication and power distribution, according to electronics team leader Dipl. Ing. (FH) Sebastian Mueller. Besides power

Figure 2: The CAN switching and display units are another mainstay; the photo shows a central control and monitoring panel for a drilling vehicle (Photo: Miunske)

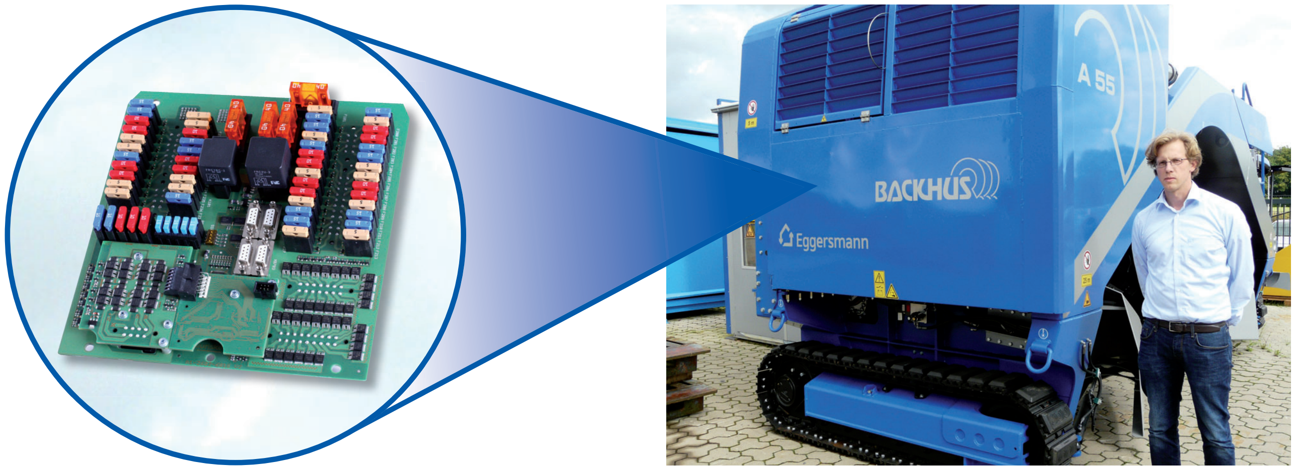

Figure 3: The development time of the all new central electronics for Backhus took no more than four weeks. The approved and ready-to-mount PCB's are now manufactured in small and medium quantities which means about 60 annually (Photo: Miunske)

distribution and switching of various loads and power circuits, the protection, and diagnosis of possible failures are vital to the system. Due to Miunske's wide spread know-how within vehicle electronics combined with a strong development competence they can provide a short-term realization of customer specific demands. The experts from the Oberlausitz region work 'on the spot' as the brand claim expresses. This incorporates development, production, and delivery just-in-sequence for their global customership.

A typical example is the company Eggersmann, located in Halle, NW. Their recycling machines, brand name Backhus, are renown worldwide and built for removing recycling material. Both companies cooperate since several years regarding these caterpillar driven machines. Instead of two free programmable central electrics modules an electronic solution had been found.

Sebastian Mueller: Although the compost remover is quite large space is the challenge. The electronics should be well accessible mounted, protected and the generated ▷

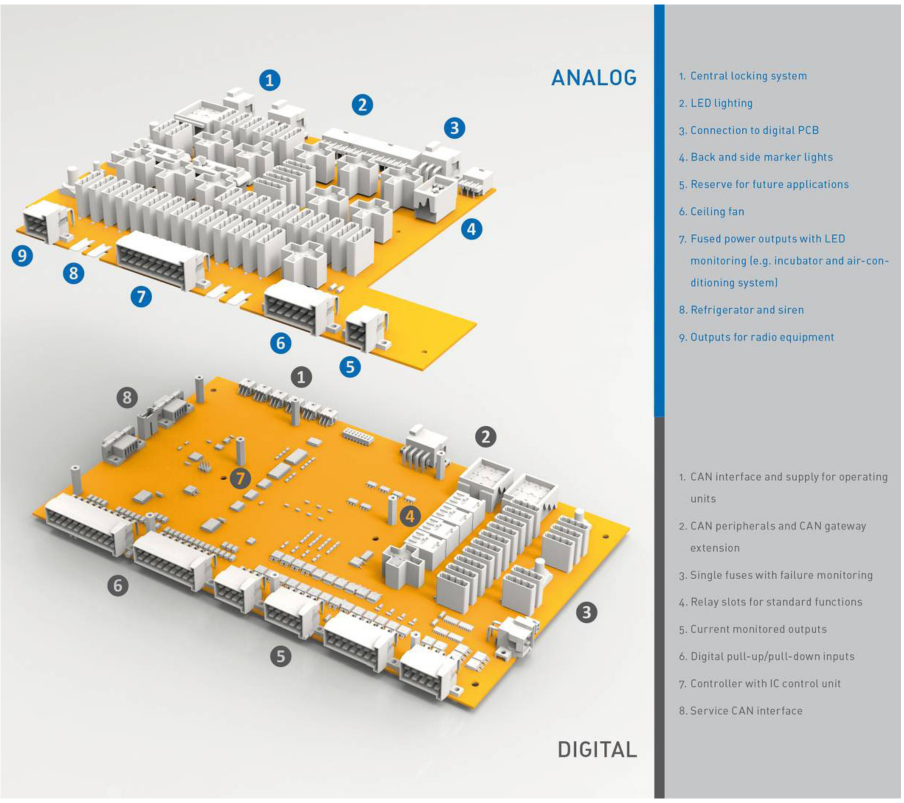

Figure 4: The CAD-drawing shows the modular concept of an ambulance's central electronics; Depending the project demands the range of functionalities can be modular varied (Photo: Miunske)

heat should be led away. The choice of the day was highly integrated semi-conductor technology. This has saved space and could add additional functions like output power control or self-diagnosis capabilities. Another positive side of the Miunske solution is: The combination of press-fit bolts and power components using soldering opens quite flexible manufacturing.

Since years bus systems connect not only but especially in off-road vehicles and machines the units like motor controls, drive train, pumps, indicator and switch panels as far as safety modules. Further on, they are vital to communicate failure transmission or remote maintenance capabilities. The broad spectrum of CAN modules provides various possibilities individualizing project designs.

They especially had been designed for mobile applications within the 9 V_{DC} to 36 V_{DC} range, carrying de E-certificate. All CAN products communicate with up to 1 Mbit/s with a free parameterized transmission rate.

The often times small numbers of European special vehicle manufacturers are almost leading to insoluble cost problems at the big players in the market.

Miunske, as family owned business, represents a highly estimated value among the special vehicle manufacturers. In the case of Backhus the approximate development time had been two months. The approved and ready-to-ship pcb's are now in production in small series of 60 pcs p.a., a successful example for a very flexible supplier.

The board, which incorporates the two daughters of the founder, their husbands, and the surrounding team of well skilled professionals can do much more - the state-of-the-art CAN switch panels and I/O modules. All will be customer specifically manufactured and parameterized through the self - developed software Miunske-toolchain. ◀

Features of the customizable device

General:
- Max. space of PCB: 300 mm x 400 mm
- Max. thickness of PCB single layer: 2 mm
- Number of layers depending on demand
- Customized hardware

Central electrics as a power distributor:
- Multi-layer PCB (printed circuit board) - popper thickness for conductor tracks up to 105 µm
- Continuous power load 150 A to 200 A
- Components (fuses, connectors, etc.) soldered, connector bolts press-fit technology
- SMD assembly used for discrete components like transistors, diodes, LEDs

Central electrics as a smart version:
- PCB with copper thickness for conductor tracks up to 70 µm
- Continuous power load up to 100 A
- Mixed components in soldering technology
- SMD assembly and press-fit technology up to 0,5 mm pitch
- Smart functions and power applications on one pcb
- Micro-controller designed for customized software
- Outputs current controlled
- Self-diagnosis capability
- Communication interface via CAN

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No excuses for not securing your CAN FD communication!

This is the third part of an article series about CAN security. It summarizes some of the discussions at CiA's security workshop and the inaugural meeting of CiA's Interest Group (IG) "CAN cyber security".

Did you use security on Classical CAN in the past? No? If you're like the authors, your arguments for not using security on CAN could have been along the following lines:

- It's only internal communications! Nobody other than a local technician will ever have access to it!
- There are no standards!
- The CAN frames are too short!
- My micro-controller couldn't handle it!

We did our best to refute the first argument in the first two articles of our series about CAN security [1]. This day and age, with more and more devices getting connected to the Internet either directly or indirectly, nobody should feel entirely safe anymore. Even if you still do, upcoming government regulations may force you to think otherwise.

But there are still no standards!

The CiA recently established the IG "CAN cyber security" in order to harmonize definitions and propose solutions. Because generic standards and solutions for end-to-end security beyond CAN (FD) readily exist (like TLS, security for transport layer) and can easily be tunneled through segmented CAN communications, the group excluded these from their scope of work and will instead focus on lower-level, CAN-specific solutions that are not standardized yet.

As a member of this group, we are able to present our generic, higher-layer-independent solution for a security layer – just above the CAN FD data link layer – that we also want to share with you.

Data size? Performance?

While in the past CAN with its 8-byte maximum payload per frame severely limited options to include security in each frame, with CAN FD this is no longer the case. With up to 64 data bytes in a frame, it should always be possible to make room for security data like signatures. In CAN, there are basically two use cases: "small data" and "large data". Small data, like process data in the form of sensor readings or actuator commands, is usually measured in bits and takes up a few bytes at the most. Even grouping multiple such values, you can always reserve some space in the – now much longer – CAN FD frame. Secure grouping of multiple nodes that transmit such small data is the primary concern in the interest group. Large data on the other hand, like configuration tables, logging data or firmware updates, will always need segmentation. In most cases, large data is better secured with some end-to-end method that we won't cover here or in the interest group. But if security is introduced to lower-level segmentation protocols regardless, the additional overhead for security should be easy to accept, even if it means not being able to use full frames for the payload. As a reminder, even in CANopen over Classical CAN and without security, segmentation would not start at nine bytes – one byte over the maximum eight bytes in a frame – but five, to leave room for the protocol overhead.

As for the micro-controller performance, there are no indications that semiconductor companies are going to include CAN FD controllers in very low-end micro-controllers. ▷

After all, they have to be able to handle not only eight times the data per frame, but also the faster data rate that the “FD” in CAN FD stands for. Typically, 32-bit cores with a core clock beyond 40 MHz are used with CAN FD – providing enough power to also run security algorithms. In addition, new micro-controllers in the roadmaps are planned to often have built-in hardware support for security algorithms like AES and others. We should take advantage of them whenever possible.

Where do we need security, and what kind?

Looking at possible CAN (FD) security solutions for individual layers, we can split these into four groups as illustrated in Figure 1:

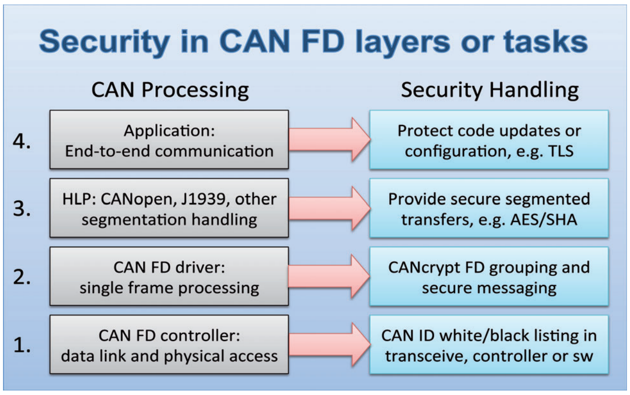

Figure 1: CAN layers and processes (Photo: EmSA)

1. Security solutions directly within the physical and data link layers: like black or white listing of CAN frame identifiers to ignore data “not authorized” for a device.
2. Security solutions for single CAN frames: the security information is embedded within the CAN frame, reducing the maximum available data size. In Classical CAN a second frame (like the CANcrypt [2] preamble message) could be used if full data size is required.
3. Security solutions for messages to be transmitted in several CAN frames: as segmentation always requires some higher layer protocol handling, such solutions should be part of the higher-layer protocol. This would secure the entire data set transported in multiple segments, and not each individual segment.
4. Security solutions for communications beyond CAN: once communications leaves the CAN bus, security mechanism “for that outside world” should be implemented. CAN, or the higher layer protocol used, only tunnels this information to the CAN device.

For the reminder of this article, we will focus on number 2, securing individual frames. We will have a closer look at the other solutions in future articles.

The security record and the digital signature

Each secure message has a security record embedded at the end of the CAN FD data field. Figure 2 shows the CAN FD frame with the location of the security record. ▷

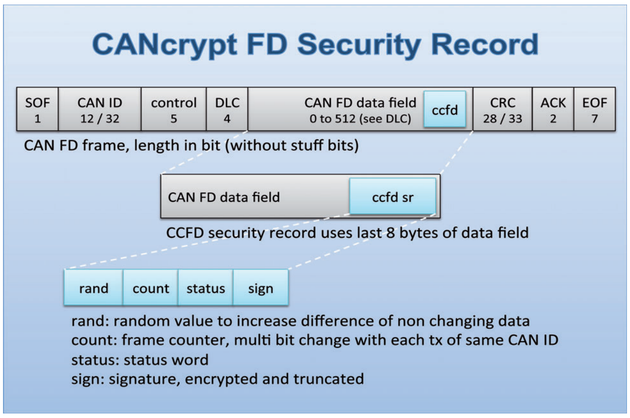

Figure 2: The CANcrypt FD Security Record (Photo: EmSA)

The default security record consists of four 16-bit values:

- Random data: increases entropy and decreases predictability of content
- Frame counter: to guard against re-play attacks, increases on transmit of frame with same CAN ID, increment value is such, that four or more bits change occur per count
- Status word: padding info, current key identification
- Signature: derived from a 64 or 128-bit checksum, encrypted, truncated to 16 bits

As popular secure hash digests like SHA-256 are quite big, CANcrypt FD uses a truncated encrypted checksum as digital signature to authenticate the message. Figure 3 illustrates how it is generated (here, with a 16-bit signature and 64-bit block cipher).

First, a buffer the size of the key is initialized. Instead of an all-zero initialization, it can also be based on another shared secret. For example, if the shared secret key is larger than required (e.g. 128-bit key, but using 64-bit encryption method), then the key could be split, one half used as main key, the other half as checksum initializer.

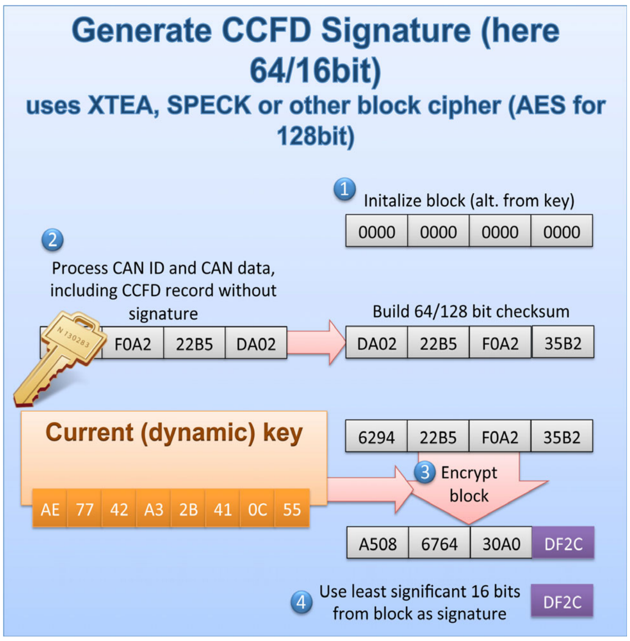

Figure 3: Generating the digital signature (Photo: EmSA)

Second step, a checksum is build. The number of bits the checksum uses is equal to the buffer width (64 or 128). It covers the CAN ID, the data field before the security record and the security record without the signature. Third step, the buffer gets encrypted using the current dynamic key. Forth step, the checksum is truncated and the least-significant 16 bits of the buffer are used as the signature.

Powering up

On power up, the devices actively participating in the dynamic key generation process start a secure grouping cycle, as in the Classical-CANcrypt grouping. All nodes that wish to participate in secure communications must monitor the key generation processes to maintain a local copy of the dynamic key. This cycle is illustrated in Figure 4. All participating devices exchange random values, which are used as an initialization vector for generating the next key from a previous or known key.

Once the dynamic key is generated, all devices (also those not actively participating in the key generation) may start using it by transmitting secure messages on the CAN FD network.

Known limitations

In its current state, CANcrypt-FD requires one dedicated CAN ID for each device and a default of eight bytes for the security record, added to the data field of every secure message. Future versions may use different-size security records, if required by specific applications.

The CANcrypt-FD mechanisms only provide one element for the security of CAN FD communications. Which specific keys and algorithms are used and how frequent a dynamic key is updated, is still application-specific. Here, we need further recommendations to avoid insecure configurations.

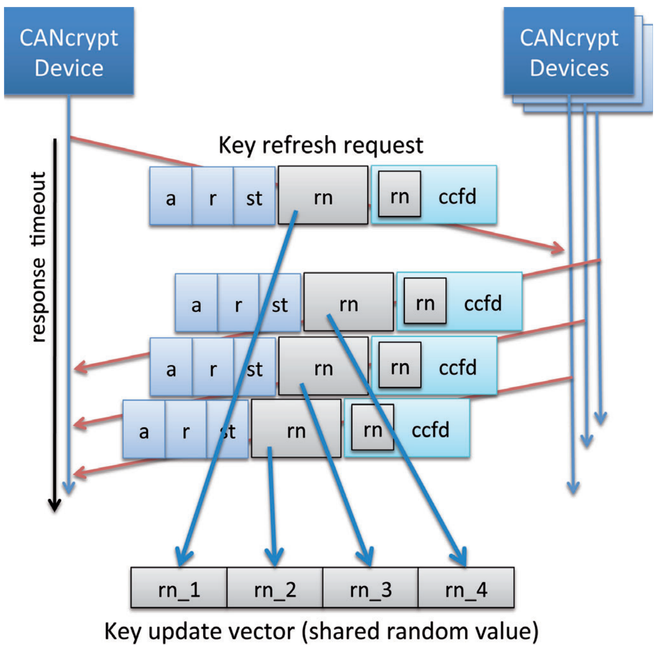

Figure 4: Generating an initialization vector for key generation (Photo: EmSA)

Brute-force or penetration testers can only be kept at bay if a reliable reset with power-up delay is implemented. If a device requests re-grouping too often or grouping fails repeatedly, then a reset with an increasing power-up timeout is required.

Outlook

A demo of CANcrypt-FD is available for the NXP LPC54618 processor. By the time of this publication it should be available for free download from the Embedded Systems Academy web pages.

We will work closely with the CiA CAN Cyber Security group to see if this solution is suitable for a wider range of applications. It is our desire to keep the main framework and security algorithms open, so that they can easily be reviewed by all interested security experts or testers.

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VCIs for the entire vehicle lifecycle

VCIs (Vehicle Communication Interfaces) in a number of variations are used throughout the entire vehicle lifecycle so a test system can communicate with the vehicle.

(Photo: Softing)

The newly developed VCIs of the VIN-ING product family from Softing take the specific requirements of engineering, manufacturing, and after-sales service into account. Hardware and software components make it possible to integrate the entire diagnostic system on the VCI. This means the VCIs are equipped for the various scenarios of remotely accessing a vehicle.

The use cases along the process chain derive a number of very different requirements for VCIs. In engineering, onboard communication over the various bus systems CAN, LIN, Flexray, and BroadR-Reach is required, alongside diagnostic and calibration functions. Interfaces for reading in data formats such as Autosar and Fibex to describe bus communication have to be provided. In test scenarios, such as road tests, or at test benches, VCIs are used with functions for data-logging, bus analysis, and the simulation of ECUs. To ensure these various demands are met, the optimal solution is for the VCIs to have a modular hardware and software concept.

The requirements made of a VCI in manufacturing are performance, performance, and more performance. This is true both of the effectively parallel communication with lots of ECUs and of the flash programming of ECUs. Fast availability in a WLAN network with good roaming characteristics continues to be essential. State-of-the-art encryption and authentication methods as well as taking the individual demands of the IT infrastructure into demand are obligatory.

In after-sales service the vehicle interfaces are mainly limited to the signals applied at the OBD connector for ISO 1941, CAN, and Ethernet. Various legacy protocols still have to be supported for servicing older vehicles. The VCI also has to be equipped for powerful and secure remote access. This is the basis for current and future diagnostic concepts as well as for software updates without the vehicle having to be taken to the repair shop (Sota).

VIN-ING 1000 was designed as a compact, low-cost VCI for after-market applications. With one to two CAN interfaces as well as K- and L-line, the VCI can be adapted ▷

Figure 1: VIN-ING 1000 - Compact VCI for simple service diagnostics (Photo: Softing)

with different diagnostic connectors using cables. Thanks to the sturdy aluminum housing with protective caps as well as a lockable USB cable, the product is equipped for the tough conditions in the repair shop environment. Communication with the workstation takes place over USB or optionally over Bluetooth. Data pre-processing and protocol handling in the interface ensure fast response times and reliable real-time behavior regardless of the system environment.

Manufacturing and after-sales service

VIN-ING 2000 was developed in response to new demands in the vehicle industry. It is the successor to the tried and tested HSC diagnostic interface and features extensive modifications. With a compact design and WLAN and USB as interfaces to the host system as well as CAN FD, K-line, and Ethernet to the vehicle, the VCI is particularly well suited for future-proof manufacturing and after-sales service applications. Highly integrated, powerful components, and a modular software architecture are the prerequisite for running an MVCI diagnostic server on the VCI and processing stored ODX data. This enables vehicles to be accessed remotely from one tester system in a whole range of mobile applications. With OTX sequences being run on the VCI, entire diagnostic tasks can be processed independently and without a connection to a host system. This makes it possible to realize applications, such as independent programming solutions, actuator diagnostics, and other control tasks, simply and at an acceptable price.

Modular communication platform

With the modular communication platform VIN-ING 3000 you are able to cover the different use cases for developing and testing vehicles. The main board is equipped with a powerful SoC (System on Chip) and a large programmable FPGA module. Using this hardware a fitting IP core can be loaded, supporting CAN FD, Flexray, and other vehicle interfaces. With up to six different slide-in modules, the perfect VCI can be put together to suit the individual use case. All standard vehicle interfaces, such as Classical CAN, CAN FD, K-line, LIN, Sent, Flexray, and BroadR-Reach, are supported. By choosing the appropriate slide-in ▷

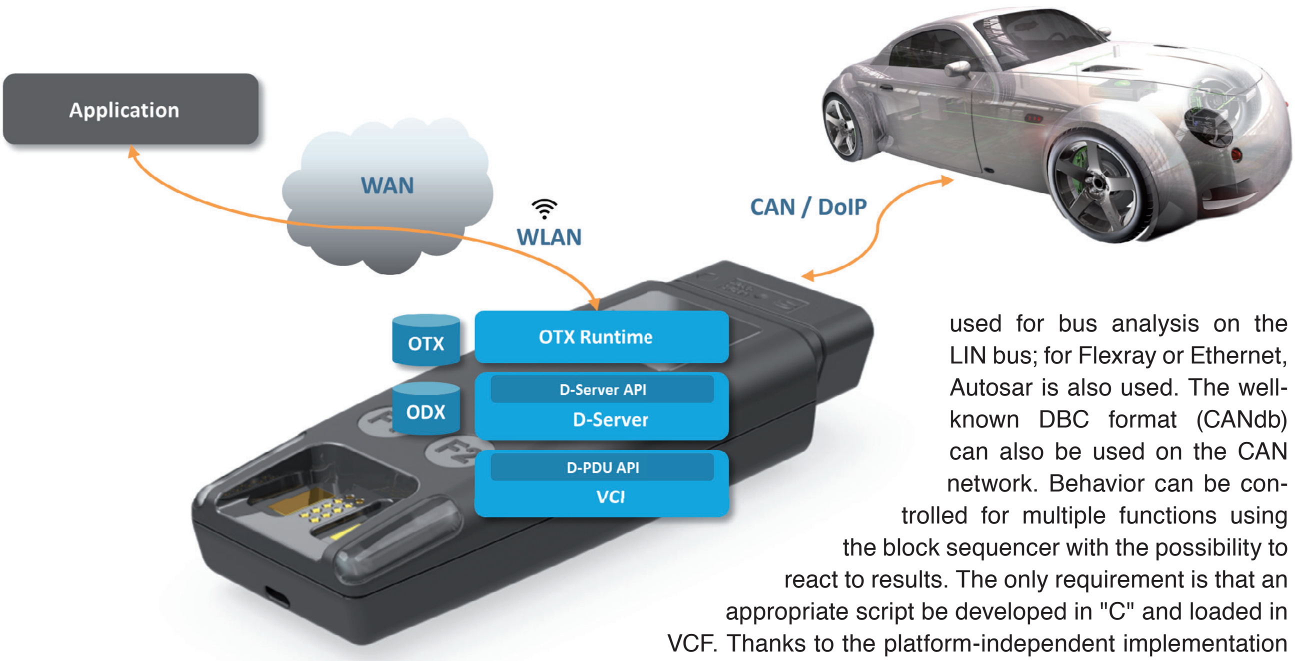

Figure 2: VIN-ING 2000 - VCI with an integrated diagnostic server (Photo: Softing)

modules, up to 24 separate vehicle interfaces in almost any combination are available. The following slide-in modules are available or in preparation:

- Module 1: CAN + UART
  2 x Classical CAN / CAN FD and
  2 x UART (K-line/LIN/SENT)
- Module 2: CAN
  4 x Classical CAN / CAN FD
- Module 3: Automotive Ethernet
  2 x Ethernet 10/100/1000 Base-T and
  2 x BroadR-Reach
- Module 4: OBD
  2 x Classical CAN / CAN FD, 2 x K-line,
  1 x Ethernet 100 Base-T

All modules are equipped with at least two freely usable I/O signals. VIN-ING 3000 is designed for two slide-in modules; six can be installed in VIN-ING 6000.

Figure 3: VIN-ING 3000 and 6000 - Modular VCI system for engineering and testing (Photo: Softing)

Paired with the new VCI Communication Framework (VCF) from Softing, VIN-ING 3000 / 6000 are suited for the use cases during the development of ECUs. The VCF modules for measurement tasks, data-logging, bus analysis, and residual bus simulation can be run parallel to diagnostic communication with a standardized runtime system. Depending on the communication function, the usual configuration methods are available. A2L files compliant with the Asam standard MCD2-MC are usually used for measuring via XCP. The LDF or Fibex format is used for bus analysis on the LIN bus; for Flexray or Ethernet, Autosar is also used. The well-known DBC format (CANdb) can also be used on the CAN network. Behavior can be controlled for multiple functions using the block sequencer with the possibility to react to results. The only requirement is that an appropriate script be developed in "C" and loaded in VCF. Thanks to the platform-independent implementation of VCF, the software can be used on Windows systems, on Linux, iOS, and Android.

Summary

The different requirements in terms of the communication of a test system with the electronic control units of a vehicle can be derived from the use cases shown. The VCIs of the VIN-ING family are a new generation of very powerful communication interfaces which cover the specific requirements of engineering, manufacturing, and after-sales service. The devices have a modular hardware and software architecture as well as standardized data and call interfaces. This means that by adding extra units, the functionality can be extended without the applications having to undergo major adaptation. ◀

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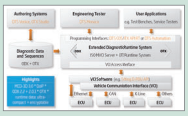
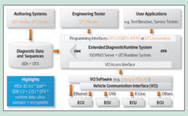


Diagnostic tool

Vehicle diagnostics supports Windows 10

Release 11 of Softing's Diagnostic Tool Set supports Windows 10 and other current platforms. It takes updated automotive standards into consideration and the maintenance of authoring systems for ODX and OTX.

Read on



Diagnostic tool set

Complete solution for vehicle diagnostics

The Release 10 of Softing's Diagnostic Tool Set offers increased performance and an extended simulation engine. The focus is on heavy-duty diesel vehicles, coding of ECU variants, and Diagnostics-over-IP (DoIP). Evaluation packages are available for J1939 and DoIP.

Read on

Vehicle Communication Interface

For mobile service applications

With its Bluetooth/USB as interface to the PC and CAN/K-Line as interface to the vehicle the VIN-ING 1000 by Softing qualifies particularly for mobile service applications.

Read on

Bluetooth interface

For vehicle electronics

The HSD VCI Interface by Samtec comes with Bluetooth or USB ports to interface with a PC. It also features CAN and K-Line as vehicle interfaces, which makes the product suitable for mobile service applications.

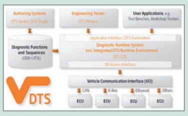
Read on

Vehicle Communication Interface

Diagnostic interface with two CAN channels

The interfaces of Softing's VIN-ING family aim to make vehicle communication concepts easy to implement with a hardware design tailored to the task. The VIN-ING 1000 comes with two high-speed CAN channels.

Read on



Vehicle diagnostics

J1939-73 in heavy-duty diesel vehicles

Release 9.1 of Softing's (Germany) Diagnostic Tool Set 8 provides full support of Windows 8.1. It also comes with a J1939-73 protocol template for heavy-duty diesel vehicles.

Read on

Motion control platforms suitable for CiA 402

Dunkermotoren has developed hardware and software platforms for motion controllers. They comprise dMove and dPro designed for efficiency respectively for applications without host controllers.

(Photo: Dunkermotoren)

The company located in the Germany's Black Forest develops and produces integrated DC servomotors based on brushless DC motors for about 20 years. During this time, a variety of functions has been created, developed and optimized. "All these existing functions, now called 'features', were examined carefully in a first step. Already this step has made it clear how extensive a new motor base must be," wrote Michael Bungert from Dunkermotoren in a white paper. "Away from a rigid system that adds one function after another to a modular system where features can be combined when required. Our new platform was not only shown in the software, but also for the hardware. Flexibility came to the fore during development. This resulted in a motor control platform that, on the one hand, reflects all previous functions and, on the other hand, can react flexibly to new requirements," he added.

The company' engineers choose the latest generation of 32-bit micro-controllers to design the future-proof platform. This allows to use existing functions even more effectively and new ones, previously not possible functions, to be introduced. Electronic labels are only the beginning. In addition to the motor data, the labels also indicate the overall data of the whole drive, including the gearbox, encoder, and brake. In the future, the platform will provide functional safety. In order to meet different application requirements, there are two types of platforms:

- *dMove:* This platform is designed for economic efficiency, dMove drives can control speed, positioning without high-resolution encoders and can assign functions to digital inputs and outputs. CANopen communication with profile CiA 402 is possible. On request, even less demanding communication via an EIA 485-based interface is provided. ▷

Robots keep artificial turf green

There is a trend in sport courts: Artificial turf pitches replace hard courts. Also an artificial turf needs cultivation. Due to the Turfrob by Melos, sophisticated cultivation belongs to the past. The robot was developed in cooperation with Dunkermotoren, Konpro, and the University of Applied Science in Dortmund. The service robot vacuums and hackles the artificial turf. It comprises a vacuum cleaner for removing leaves and small branches. Dunkermotoren provided three drives, which are responsible for the cleaning. The drives from Dunkermotoren are used for the adjustment of the vacuum and nozzle unit. They are connected via their CANopen interfaces to gyroscopes and I/O devices as well as the embedded PC-based host controller.

The Turfrob is equipped with three drives, which communicate with the host controller via CANopen (Photo: Dunkermotoren)

Furthermore, during the match the infill gets compressed. To ensure constant match conditions, the artificial turf needs to be slackening regularly. With the robot this is made without more ado. Visualize a soccer match: The penalty area gets hard burdened through the soccer shoes. Duels, corners, and goal box scenes – the maximum density of soccer players is there. Imagine how extreme the mechanical load is which comes down to the fiber of the artificial turf – then it's inevitable to cultivate them to ensure the durability of the artificial turf. The BLDC motors enable the adjustments of the brushes in the front and of the currycomb unit in the back.

Two more drives are used for the driving operation. To keep the control about the robot anytime it is controlled by an app. It enables the simple programming and selecting of programs according to the type and cultivation intensity. Afterwards the app connects automatically with the robot and starts its program.

With an efficiency of up to 90 percent and the possibility of regenerative operation BLDC motors make a demand-based distribution of energy possible and so long battery life.

▷

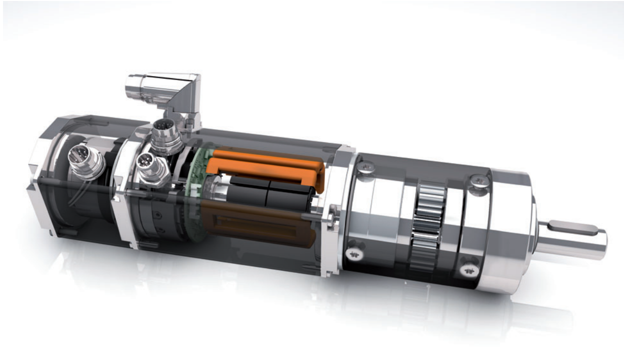


Figure 1: BG66 dMove application (Photo: Dunkermotoren)

- *dPro:* Customers who want to outsource all or only parts of their PLC functions to the motor will find their solution in dPro drives. These drives are also used for interpolation, communication via Industrial Ethernet, jerk-optimized ramps, absolute encoders, and high-end motion functions. Of course, they are also available with CANopen (CiA 402) connectivity.

The development of this motor control platform has now been largely completed. At last, the product launch can begin. Already available is the BG 95 dPro. A powerful motor with integrated electronics and a maximum output power of 2,6 kW, which offers the maximum functionality with the "dPro" characteristic. It can operate as a slave in the CANopen network, can be controlled directly via digital inputs without a communication interface or, can be freely programmed similar to a PLC (programmable logic controller). The BG 95 dPro has already demonstrated that the concept of the new Motor Control Platform has proven itself in practice. Typical applications included intralogistics systems, electromechanical presses, mechanical test equipment, door drives, and special pumps.

The next products to be rolled out are BG 65 and BG 66 dMove. These two DC servo motor series' have the same size but different output power. BG 65 features 120 W (continuous) respectively 260 W (peak). Due to high-quality neodymium magnets, the BG 66 provides a 170-W (continuous) output power and more than 400 W of maximum output power. For the first time, the modularity of the motion control platform has been exploited in these series.

In the medium term, BG 65 and BG 66 dMove will primarily replace the hundred thousand times installed classic BG 65 SI drives. In addition to the basic functionality, namely the speed control, functions such as fixed speeds, preset positions or values for current limitation can be assigned to the digital inputs in the future with the "Drive Assistant 5" commissioning software. Since the control is done via the digital inputs, this version is called dMove IO. If even greater flexibility is required, dMove CO motors (CO - CANopen) can operate as a slave via a CANopen interface. If no high-resolution encoder is required, it is in many cases also possible to replace existing BG 65 CI motors.

The modularity does not end with the motor electronics. Gearboxes, encoders, and brakes from the company's modular system also turn a DC servo motor into a DC servo drive. The electronics adapts to the expansion ▷

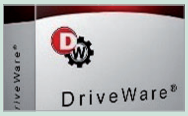
CAN Newsletter Online: CiA 402

Frequency converter

Used in water-based refrigeration unit

The refrigeration unit eChiller from Efficient Energy integrates Sieb & Meyer's SD2S drive amplifiers with Classical CAN and CANopen support. The chiller uses pure water as refrigerant and operates in a capacity range of 35 kW.

Read on

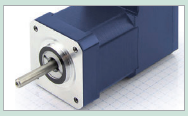


Software tool

Configures servo drives

Advanced Motion Controls announced the release of the Driveware 7.4.2 software for commissioning, troubleshooting, and integrating the company's Digiflex Performance servo drives. CANopen (CiA 402) is supported.

Read on

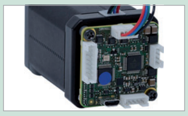


Brushless DC servo motor

With integrated controller

For use in harsh environmental conditions, Nanotec (Germany) developed the PD2-C-IP. It is a brushless DC servo motor with integrated controller and 42 mm flange size in protection class IP65.

Read on



Stepper motor drive

Positioning with up to 5000 min^{-1}

Trinamic (Germany) has announced the extension of the Pandrive product line by the PD42-3-1241 and the TMCM-1241 modules. They provide CAN connectivity.

Read on

Positioning controller

With CANopen interface

Maxon Motor (Switzerland) has developed the Epos4 70/15 positioning controller, the most powerful model of this series. It provides a maximum output of 2,1 kW.

Read on

Motion controller

Driving up to three DC motors

Roboteq offers the FDC3260 motion controller, which supports the CiA 402 profile. It is able to control up to three motors.

Read on

components and thus protect the complete drive and the application against critical operating conditions. Sophisticated algorithms ensure that the drives can be overloaded by a multiple of the continuous output power for a certain period, without getting damaged. ◀

hz

www.dunkermotoren.de

CAN in the days of US tariff battles and the German export surplus

(Photo: Fotolia)

There are dark clouds in the sky: China and USA started a trade war and Germany's industry export is still not balanced.

The success of CAN is overwhelming. This year, 90 million cars – most equipped with multiple CAN networks – require the largest amount of CAN transceiver chips. CAN networks are not just used in passenger cars; they could be in any control system comprising more than two micro-controllers. NXP, the market leader in CAN transceivers, carries them truck-wise out of its factories. But the CAN business might be affected by the general political and economical situation: The US tariffs on Chinese products have impacts on the CAN business as well as the export surplus of Germany.

US tariffs on Chinese products and the response

Beginning of July, the US administration launched the first tranche of tariffs on $34 billion worth of Chinese products, because President Donald Trump accused China on unfair trade practice. This included also motorcycles, speedometers, and some other electronic equipment. The Chinese response came immediately: Beijing imposed tariffs on passenger cars and other goods with the same value. The second tranche of tariffs went into effect by end of August. Its value is $60 billion. Half of the list is related to investment goods – including micro-controllers (8542.31.00), control panels (8537.10.30, and electric motors (8501.nn.nn). But at the end, we all have to pay it. Tariffs take money from our pockets into the treasuries of Washington and Beijing.

Especially the automotive industries are highly networked, linked, and intertwined. The used ECUs are developed and manufactured mainly in Europe, North America, and Japan. It is paradox: The Japanese Honda Odyssey is the car with the highest portion of parts made in North America. The ECUs implement integrated circuits; the majority of them is assembled and tested in Asia. The chip developments are done mainly in North America, Japan, and Europe. In case of CAN, most of the protocol cores and transceivers are designed in Europe in close cooperation with German and European OEMs (original equipment manufacturers).

The first round of Trump's tariffs affected the purchasing departments of the US automakers. About 40 percent of the content in GM's US-sold vehicles comes from outside the United States, while that figure is 45 percent for FCA and 20 percent for Ford, according to data from research firm Edmunds.com. But just a few CAN-based ECUs are made in China. But when China responded with tariffs on products made in USA, the automakers saw impacts on their business. GM, for example, sells more cars in China than at home. Top managers from FCA, Ford, and GM talked to the US President without changing the mind of Donald Trump. They informed him that the 25-percent tariffs by the Chinese government would raise the price of US vehicles, which could cost jobs in the USA.

Even the German BMW, producing all of its SUVs in South Carolina, exports more of these vehicles to China than selling SUVs in the USA. As said, the automotive industry is a complex network of OEMs, Tier1s, and other suppliers. Changing the supply chain is not that easy, because of long-term contracts and technology partnerships.

It is somehow paradox: In some cases, the US chipmakers have to pay tariff on their own products, because they are assembled and tested in Far East. ▷

They also purchase from China some machinery for their production lines. This is, why the SIA (Semiconductor Industry Association) wants the US Administration to remove 39 products from the tariff list. Still SIA and its members support the aims of the US Government to curtail China's industrial policies and practices on IP (intellectual property) rights. In a statement, the association said: "While the US semiconductor industry shares the Trump Administration's concerns about China's forced technology transfer and intellectual property (IP) practices, the proposed imposition of tariffs on semiconductors from China, most of which are actually researched, designed, and manufactured in the US, is counterproductive and fails to address the serious IP and industrial policy issues in China. We look forward to working with the Administration to explain why imposing tariffs on our products would be harmful to our competitiveness and does not address our challenges with China."

In order to avoid a war on two fronts, China tries to strengthen relations to Europe. Beijing's government allowed for the first a joint venture, in which the foreigner has more than 50 percent of the shares. BMW, one of the German premium automakers, gained the right to take an equity stake in Catl, a world-leading Chinese manufacturer of vehicle batteries. China is well-prepared to improve trade with Europe and Africa. The One Belt, One Road project is part of the long-term Chinese business strategy (see CAN Newsletter 1/17).

Also, the US Administration tries to avoid a second front. The verbal attacks by Donald Trump on Twitter against Germany did not follow actions up to now – just sable-rattling for the moment.

So far, the American-Chinese trade war has not many consequences for the CAN chipmakers, because the big ones are in Europe and Japan. Cypress, Microchip, and Texas Instruments may have some disadvantages. The automakers need to reorganize some of their supply chains in the short-term and may consider new production lines in China. The market-leading ECU suppliers are headquartered in Europe and Japan. According to the Top 100 list by Berylls, Bosch, and Continental (Germany) defended last year the two first places followed by Denso (Japan), and ZF (Germany). In 2015, ZF acquired TRW Automotive (USA). On the list are just four Chinese companies, two of them for the first time. The US suppliers are ahead in profitability with an average of 10,2 percent compared to the average of 9,8 percent.

Impacts on non-automotive CAN markets

Non-automotive markets are wide spread: From rail vehicle via medical devices and elevator control systems to embedded machine controllers. The tariff lists of the US Administration and the Chinese government are long. CAN device manufacturers may be affected or may be not. This is a matter of chance.

CiA member Trionic (USA) did not report any problems: "We have China contract manufacturers shipping both to USA and to France and we've seen no tariff impact. Probably because the customs tariff code we use, is unaffected." The company provides among other products, CAN-based I/O devices, vehicle controllers, and electrical and hydraulic drives. Recently, the Xtreme XR1055s telehandler was equipped with the CAN-connectable GP400 controller by Trionic.

Also CiA member RFID (USA) is optimistic. President James E. Heurich sees no impacts: "In terms of a negative way, not so much as we import only a few items from China. Most of our products are made in the USA. On the positive side, we have already begun to see traction and gained some accounts, one in particular for $280 000 per year due to the fact that we are now able to compete on a price basis. Most of our competitors are German, a few Japanese, in the industrial identification or factory floor space. It simply is not possible for our company to sell into Europe given the tariffs, we have very little market there and must price our products low in order to win the few projects we have there. But we welcome the ability to once again be able to compete fairly here in the USA".

In opposite, Applied Motion Products (USA), another CiA member, informed its customers about increased prices due to the tariffs: "Most of the motors, drives, gearheads and other essential components within Applied Motion's product offering are included on the lists of goods that will incur new tariffs of 25 percent." The company announced a 15-percent surcharge to all products affected by the new tariffs. "We believe there is uncertainty in these new regulations and we are not confident that the China tariff situation will not change again soon. Accordingly, if the tariff situation changes we may increase, decrease, or eliminate the surcharge applied to our products." The company is engaged in seeking exclusion of impacted products and essential components from the tariffs.

Germany's current account surplus decreases slightly

Another economical problem is the German export surplus. In 2018, it is expected to decline to 7,8 percent (2017: 7,9 percent). Economic researchers regard 6 percent as sustainable in the long term. "The decline is attributable to three factors: the surplus in goods exports is unlikely to increase, income from foreign assets is set to decline slightly and, in addition, annual economic output, including inflation, will rise sharply – by 3,7 percent," stated Christian Grimme from the IfO Institute of Economic Research (Germany). Sustained high current account surpluses can become problematic, if receivables cannot be redeemed, for example, if foreign countries are no longer able to service their interest burden.

Germany is, as in the previous two years, the country with the largest current account surplus again in 2018. With an expected $299 billion, the German value is ahead of that for Japan, which in the current year is expected to show a surplus of approximately $200 billion dollars. In third place will be the Netherlands with around $110 billion. By contrast, the USA is again likely to be the country with the largest current account deficit at just under $420 billion, which, however, is only 2,2 percent of its annual economic performance. ▷

Figure 1: The Top 100 automotive suppliers grow stronger and are more profitable than the Top 10 automakers (Photo: Fotolia)

The expected surplus in the German current account is attributable to trade in goods; based on the figures for the first half of 2018, there is likely to be a surplus of around $300 billion for the year as a whole. The main driver for exports of goods in the first half of the year was demand from other €-area countries, other EU countries, and the USA.

This year, China will no longer be among the top three countries with the highest surpluses. Due to very strong imports and weaker exports, China's goods surplus was significantly lower in the first half of 2018, with especially less being exported to the US and Europe.

In regard to the automotive industry, German Tier1 suppliers contribute a significant part of the export surplus. The market researchers from Berylls analyzed that German automotive suppliers showed even more positive figures. They increased their average profitability, which was already at a level of 9,5 percent (2016) to 9,8 percent in 2017 – only topped by US suppliers (10,2 percent). Revenue across all 18 German companies in the Top 100 list grew by a total of 7,5 percent. Overall, the German suppliers thus moved up by six places on average into the Top 100 ranking. Many of them provide CAN-connectable ECUs.

Also non-automotive CAN devices made in Germany are export hits. Especially, CAN-connectable drives and motion controllers are popular. Of course, also encoders and inclinometers with CAN interfaces are developed and manufactured mainly in Germany. Of course, production could be outsourced to other countries. However, 'Made in Germany' is still an important sales argument. ◀

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Calming the seas with CAN

For non-boating experts, it may be a surprise to learn that boats don't have to make that seasickness-inducing roll anymore. A CAN-controlled gyroscope is proving a highly effective solution.

(Photo: Seakeeper)

Maximizing stability has both practical and comfort benefits: it's safer and more pleasant for all onboard, whether you happen to be hauling in fishing nets, patrolling heavy seas, or drinking champagne on a luxury yacht.

The traditional "anti-roll" solution is a set of movable fins that sit externally at either side of the keel. Whether fixed or retractable, these angled fins generate a corrective hydrodynamic force that opposes the rolling force of the waves. The solution is speed dependent, with specification requiring that fin size is balanced with the projected cruising speed.

A relatively new kid on the block is Seakeeper's gyro stabilizer. It is a computer controlled gyroscope that eliminates most boat roll, including the fatigue, anxiety, and seasickness that go with it. The calm-inducing combined hardware and software system can be installed virtually anywhere on the boat, because it requires no external equipment outside the hull. A gyro stabilizer works by spinning a flywheel inside an enclosure at high speed, creating an inertial force forward and aft that counteracts the side to side roll. A major selling point is that it will work at any speed, even when the boat is stationary.

Seakeeper has developed a particularly sophisticated anti-roll gyro that eliminates up to 95 % of boat roll on vessels 8 meters and up. A unique feature is its vacuum-sealed enclosure, which protects the gyro's flywheel, bearings, and motor from the marine environment and facilitates a smaller, lighter, and less power-consuming design. This solution uses the CAN network to coordinate a distributed control system.

Among the attributes that set Seakeeper's gyro apart from competitor solutions is its "smart" nature, whereby it automatically gauges variables including sea state and boat speed, then optimizes performance quasi-instantaneously. Explaining CAN's role in the Seakeeper ▷

About Kvaser's Leaf Light Rugged and USBcan Light 2xHS

The Kvaser Leaf Light R v2 is the rugged version of the Leaf Light v2 interface. This is a single channel CAN interface with a lightweight yet highly durable, IP65-rated housing that assures protection against water and dust ingress. Vibration, shock, and drop proof, this interface belongs to Kvaser's Rugged range and operates over a temperature range of -40 °C to +70 °C.

With a standard USB 2.0 connection and a high-speed CAN channel in a 9-pin D-SUB CAN connector, it handles transmission and reception of standard and extended CAN messages, with a time stamp precision of 100 microseconds. Features include error frame detection and LED indicators for power and CAN channel status.

The Kvaser USBcan Light 2xHS connects two high speed CAN networks to a PC or mobile computer. With a USB 2.0 compliant connector at one end and two CAN 9-pin D-SUB connectors at the other, it is a fraction larger than the one-channel Leaf Light v2. It still features the same sleek, designed housing that Kvaser products have become renowned for and comes with galvanic isolation as standard though.

This device is designed to facilitate any application in which the CAN connectors aren't easily accessible, such as hard to reach electronic control units (ECU) on a vehicle. It is fully compatible with J1939, CANopen, NMEA 2000, and Devicenet.

cw

control system, Bob Lawrie, Director of Advanced Projects at the company: "We use the CAN bus to coordinate various sensor readings and actuator outputs to optimize stabilization. Our CAN network has a system controller, an IMU (which senses boat motion), a drive (which powers the motor that spins the flywheel), and a user interface display. We also have a second, electrically-isolated CAN bus located in the user interface display that allows replication of the user interface functions on larger display screens."

During control system development and testing, Seakeeper used a combination of the Kvaser Leaf Light Rugged and Kvaser USBcan Light 2xHS to connect to their calibration tools. Recounts Lawrie: "As a calibration tool interface, these provide access to all data needed to monitor and log data, adjust calibration parameters, and optimize the control system. We also use the Kvaser interfaces to log data to proprietary software during our final assembly test qualifications and to program the controllers on the CAN ▷

Figure 1: Seakeeper's gyro stabilizer (Photo: Seakeeper)

Figure 2: Kvaser's Leaf Light in action (Photo: Seakeeper)

bus during production and for software updates in the field."

Sea trials are a key part of Seakeeper's test procedures, enabling Kvaser to provide high levels of value add to the firm's validation processes. According to Lawrie: "We started using Kvaser because they are compatible with the calibration tools that we use for software programming and testing. From there, we found they were useful, rugged and cost effective to use in our production process and during our extensive testing programs. Kvaser's interfaces have proved to be rugged and reliable in harsh environments, where there is regular exposure to salt water, high shock loads, and temperature extremes." Seakeeper also uses Kvaser's free CANKing software for traffic analysis and sending messages during development.

Seakeeper caters to vessels from 7 t up to 100 t (the size of a small cargo ship or tug boat). Larger vessels can be fitted with multiple units to achieve optimal results. While the system's sophistication may result in a higher initial investment cost compared to a traditional fin stabilizer, the benefits include increased stabilization at zero speed and reduced drag which improves top speed, fuel consumption, and range. The upkeep costs of a gyro are potentially also lower than an external fin as there's no risk of snagging on marine detritus or seaweed, or damage from grounding when operating in shallow waters. CAN has been the mechanism by which a host of electronic devices connect to each other via a central backbone to control complex electro-mechanical systems. ◀

CAN Newsletter Online: Kvaser

Interface board

Classical CAN, CAN FD, or LIN

Kvaser has released the Kvaser Hybrid Pro 2xCAN/LIN. It is a dual-channel interface that allows automotive engineers to configure either channel as Classical CAN, CAN FD, or LIN.

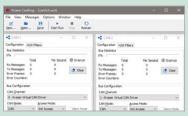
Read on

CAN data-logger

Used to develop a student racing car

Tongji Dian Racing from Tongji University performed well in last year's Formula Student China ranking 4th. Kvaser's CAN/CAN FD data-logger was part of it.

Read on



Software release

Python and continued updates to formatters

Kvaser's latest software release includes yet more improvements to it's Python resources. Additionally it adds a new J1939 formatter in the Canking version 6.7.

Read on

Cooperation

Interested in CAN and LIN interfaces

Kvaser (Sweden) has announced that Pertech Embedded Solutions (Israel) has joined Kvaser's sales representative network. Especially the CAN- and LIN-based products seem of interest.

Read on

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Good to know: Passive error flags

Error passive frames comprise the 6-bit error flag (all recessive), the 1-bit to 6-bit overlapping error flag caused by other nodes, and the 8-bit recessive error delimiter. The ISO 11898-1:2015 standard reads "the passive error flag is complete when these 6 equal bits have been detected". What does this mean? It means, when a receiving node in error passive mode, which has signaled an error, is detecting 6 consecutive recessive bits (length of the passive error flags) on the bus, it completes its passive error flag. Now, this node is allowed to transmit CAN frames again.

If there is heavy traffic, on the bus by other nodes, it can take a while, until the passive error flag is completed. In this time, the node is not able to transmit other data frames.

When the error flag is sent, the other nodes might not detect this passive error flag at all, because they cannot distinguish between bus-idle (recessive state) and the error frame made entirely by recessive bits.

This is a critical situation from the viewpoint of the network system. Data consistency is not more provided. Therefore, the application layer should take care on this scenario. In CANopen, the Emcy message is used to indicate to the other nodes, that the CAN interface of this CANopen device is in error passive state and cannot indicate a corrupted data frame received from another node. But you can do more: The CANopen device can already transmit an Emcy message, when it reaches the error warning level (by default 96 for TEC and REC). Therefore, CiA recommends supporting the related 8120_h error code in Emcy messages. Reaching the error warning level, can also be indicated in the EMCY message in the manufacturer-specific field.

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