

# Loading automotive software made easy by a CAN/LIN flash bootloader

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FLASHING – THE LOADING OF ECU APPLICATION SOFTWARE INTO THE CONTROL UNIT’S MEMORY – IS BECOMING MORE AND MORE COMMON IN THE AUTOMOBILE INDUSTRY. VECTOR INFORMATIK HAS MADE THIS JOB EASIER WITH ITS CANFBL FLASH BOOTLOADER.

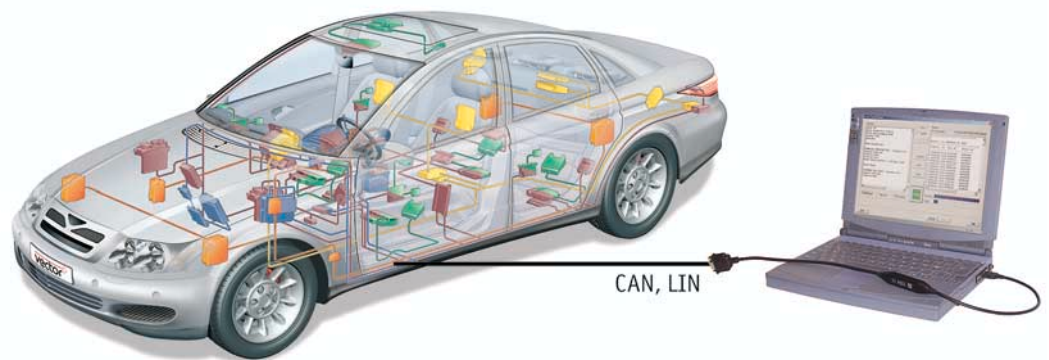


Figure 1. Download of application software onto the control unit via the CAN or LIN data bus

■ The CANfbl Flash Bootloader is an embedded software component that establishes a connection between the development or serial control unit as well as a main computer and supports the downloading of application software onto the control unit via the CAN or LIN data bus. Developers of control units benefit from this solution in more ways than one. They can delete software in seconds flat and import new software into the control unit without having to remove it. Developers even have the option of just reflashing parts of the application. That way their control units will always have the most up-to-date software. The Flash Bootloader is a customized product that is specially configured according to the needs of the customer. For flashing, all the user needs is a Windows PC with a CAN/LIN interface, for example an interface from the Vector XL family or a shop diagnosis tester.

Until just a few years ago, developers used to store ECU application software on an EEPROM storage unit where it took a lot of effort to delete it later on. In contrast, the flash ROM components that have been on the market for several years are a suitable solution for reprogrammability. Thanks to mass production, the purchase price has dropped considerably. In the meantime, this has made exchanging control units more time-consuming and more expensive than flashing. Consequently, more and more au-

tomobile manufacturers rely on replacing software in the control unit by reprogramming via CAN or LIN. Some automobile manufacturers are already able to flash all ECUs of a model in certain vehicle models. In the meantime, flash technology is being used in almost the entire development and life cycle of a vehicle model.

During development, series-dependent software is flashed into the control units and, under realistic conditions, errors are eliminated and the system optimized. In the past, suppliers of the control units sometimes used proprietary in-house flash solutions. However, it was not until the introduction of universal systems such as the Vector CANfbl Flash Bootloader that high-performance, standardized transmission became possible. Like suppliers, automobile manufacturers use the CANfbl Flash Bootloader at the end of the production process in order to import the serial software into the control units. This enables even the newest software developments to be taken into consideration.

There are numerous opportunities for using flash technology in the shop, for example, for successively optimizing serial software or enhancing vehicle functionality. For example, the functional scope of a display in the cockpit can be increased by just using new software. Flashing application software is done in the shop using diagnosis test devices. Currently, automobile man-

ufacturers are massively expanding software version management in order to definitively control the increasing number of software variants and versions in the future. For example, shop users have to be able to easily identify and flash the necessary software. At the same time, it must be guaranteed that only a defined user circle obtains access to the software databases.

The CANfbl Flash Bootloader by Vector substantially simplifies software downloading. With the push of a button on the PC CANfbl interface, the flash process starts running automatically. Once the flash process has been successfully completed or if an error appears, a message is displayed on the screen. Error messages are displayed if the flash process finishes prematurely due to an interrupted cable connection or if the software identification process detects an unsupported application.

The CANfbl Flash Bootloader consists of three components: a bootloader, a flash driver and a flash tool. If the microcontroller's memory supports it, the bootloader is integrated into the protected memory of the control unit and, as a rule, cannot be removed from it. When booting up the control unit, the job of the bootloader is to check that it's showing the right application. If this is the case, the bootloader branches out in the application in order to assume normal operation of the control unit. But should the

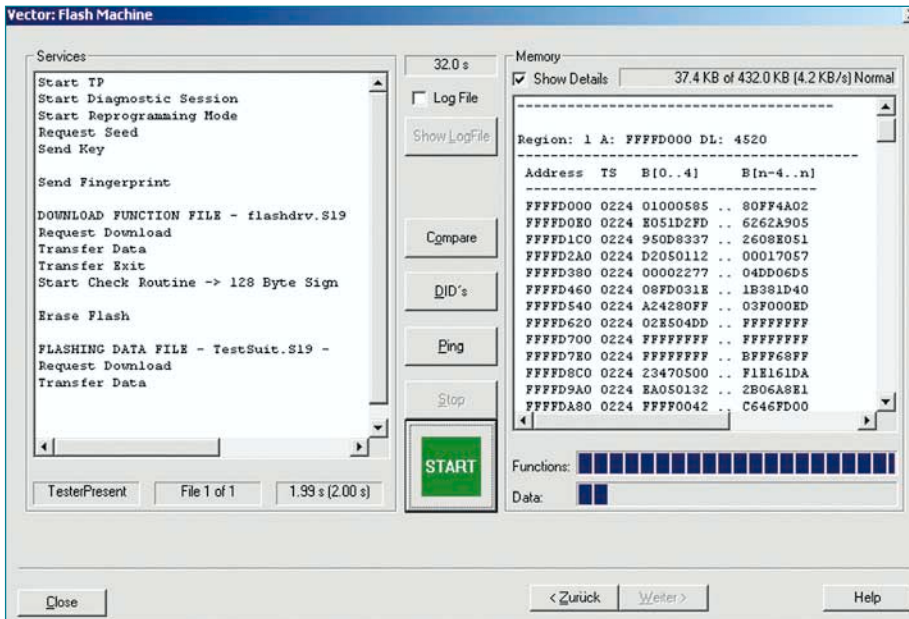


Figure 2. Loading an ECU application using the Vector download tool

bootloader find that no application or an invalid application is present in the control unit, it changes over into standby mode. Furthermore, it is possible to contact the bootloader using a diagnosis tester or the flash tool in order to initiate the download of application software via the bus. In order to keep as much memory as possible available in the control unit's memory, the CANflb by Vector contains just those functions of the CAN driver, the transport protocol and the diagnosis layer that it needs for its job.

The second component of the Vector solution is the hardware-specific flash driver that operates in the control unit's microcontroller. Its purpose is to delete the current application from the flash component and to import the new one. The flash driver is only activated for the flash process. This prevents it from being unintentionally accessed during normal operation of the control unit and thereby accidentally deleting the application. The software driver is imported and performed in the flash component only for the flash process. Afterward, it is immediately removed again. Like the flash driver, it could otherwise be unintentionally called up during the control unit's normal operation.

The third component – the flash tool – allows the flash process to be monitored on the PC screen. Thanks to light data processing, the

CANflb is an important tool in development that is also useful for the end of the production line. In the shop area, the diagnosis tester takes over the flash tool's functionality.

Thanks to the experience it has gained from many flash projects with various automobile manufacturers, Vector has gathered extensive know-how in this field. Its customers benefit from this know-how when implementing their individual Flash Bootloader solutions. Although the CANflb's modular design leads you to assume it is a standard design, almost every flash unit is a unique product that is specially adapted to the needs of the customers. In consultation with automobile manufacturers, individual configurations are developed and tested so that the supplier obtains just the right solution. At the same time, the architecture offers enough flexibility in order to be able to operate complicated applications.

Two examples: the transport protocol in the Bootloader and the KWP2000 diagnosis layer are adapted exactly in accordance to the customer's specifications, which can vary from control unit to control unit and vehicle model to vehicle model. Even the flash driver is specifically adapted to the flash component, the microcontroller and the derivative. Because depending on the microcontroller, the flash driv-

er has to meet certain requirements specified by the chip manufacturer.

Vector implements the CANflb Flash Bootloader for all standard microcontrollers, but also supports less common variants upon request. Currently, about 30 different microcontroller families, including numerous derivatives, are supported. In addition to the standard configuration (control unit with an internal flash component), automobile manufacturers are also integrating special controller configurations into the vehicle. For example, with a second microcontroller in the control unit that is not networked via the CAN data bus, or with an additional external flash memory outside the microcontroller. Even in this case, Vector configures CANflb in such a way that its flash driver can effortlessly delete and store the application on the respective target hardware. Furthermore, in addition to the manufacturer-specific operational sequence, Vector offers the option of also integrating solutions independent of the manufacturer that can be used at the supplier's production line end.

Setting up access authorizations for the use of application software in the shop already implies that the topic of flashing also has a legal dimension. In the end, the car driver has to be able to trust that, after flashing, exactly the right software is loaded onto the control unit. The Flash Bootloader takes this requirement into consideration by checking the application for accuracy every time it boots up. Also, many automobile manufacturers require that service engineers in the shop use the Flash Bootloader and modern encryption technology to register themselves on the control unit before being allowed to carry out a flash process.

But Vector confronts potential uncertainties much earlier on. Together with automobile manufacturers, suppliers and chip manufacturers, Vector specialists identify potential problems as early as the development phase and carefully synchronize all CANflb components and the external specifications to one another. The Bootloader software is validated by automobile manufacturers and the flash algorithms by suppliers of control units and chip manufacturers. This care in combination with many years of experience based on numerous successful customer projects makes the CANflb Flash Bootloader a useful companion for control unit software management in the automobile. ■