RAID Controller

Installation and configuration

Important information about data security

Before the installation or changing the configuration of the RAID controller a data backup should always be performed. Dawicontrol assumes no liability for data loss resulting from the use, failure to use or incorrect use of the RAID controller.

Note

Despite careful checking by Dawicontrol, no liability can be assumed for the technical, typographical and general correctness. Furthermore no liability can be assumed by Dawicontrol, for errors or direct, indirect, consequential or other damage, including loss of data and loss of profit.

Windows™ 2000 / XP / Vista / 7 / 8 / 10 / 11
Server 2003/2008/2012/2016/2019/2022/2025
Linux 64-Bit Kernel Version 5 upwards

14. Edition

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1 Introduction

1.1 Foreword

Thank you for your confidence and congratulations on purchasing your new Dawicontrol RAID controller. In this manual we would like to introduce you to your controller and assist you with the hardware and software installation. Although the manual describes all features and capabilities, please contact us for further information and assistance by our free telephone hotline and our FAQs at www.dawicontrol.com. The latest version of this manual as well as the BIOS and the associated software is available on our website www.dawicontrol.com at "Support / Downloads / SATA / IDE RAID".

1.2 The IDE, EIDE and UDMA standard

The IDE (Integrated Drive Electronics) interface for mass storage devices defined by a manufacturer consortium in 1989 has very quickly become the standard interface for PCs. Due to its limitation to 504 Mbytes, the IDE interface was soon replaced by the EIDE standard (Enhanced Integrated Drive Electronics), which was implemented in approx. 80% of all PCs at the end of the 90s. This interface supports data transfer rates up to 33 and 66 Mbytes/s. To further increase this speed, the UDMA standard (Ultra Direct Memory Access) was introduced, which increases the transfer rate up to 133 Mbytes/s.

1.3 The Serial ATA standard

SATA-IO, an organisation of several leading PC technology companies, has developed the Serial ATA standard as an interface for hard drives and ATAPI devices. The Serial ATA standard is intended and designed as an extension and renewal of the former ATA standard and is therefore full software compatible. However, it uses reduced signal voltage and has a reduced number of data lines. This makes the new standard faster and more reliable. This also results in slimmer and longer cables, which in turn improve ventilation of the PC housing as well as handling. Newer Serial ATA standards (generation 2 and 3) bring additional developments to increase performance. For example, data transfer rates up to 3 or 6 Gbit/s, NCQ (Native Command Queuing) and improved hot-plugging of the devices are now supported. Port multipliers can be connected and external connections, cables and devices are specified.

1.4 The PCI / PCI-X / PCIe standard

The Peripheral Component Interconnect (PCI) bus system developed by Intel in 1993, is found in most major computer architectures (i.e. PC, Apple and Alpha). Thanks to the standardization and documentation available down to the last detail, it offers computer peripheral manufacturers the opportunity to manufacture devices that are maximally compatible with this system. The so-called plug & play enables the PCI bus to recognize and configure devices automatically. In the PCI specifications, the bus width is set to 32 or 64-bit and the clock frequency to 33 or 66 MHz. This results in data transfer rates of 133 to 533 Mbyte/s.

In 1998 the PCI Special Interest Group (PCI-SIG) has developed the PCI-X standard. The PCI-X version 1.0 specified here is based very closely on the PCI bus described above and is therefore downward compatible. By increasing the clock frequency up to 133 MHz, a data transfer rate up to 1.066 GByte/s is supported. The internal address range has been expanded from 32 to 64-bit, which enables parallel operation with main memory >= 4 GB or with several other controller cards.

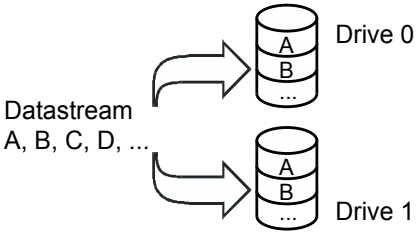
PCI Express or PCIe in turn is the successor of PCI-X and offers a higher data transfer rate per lane compared to its predecessors. With the PCIe bus, the bandwidth is not shared; each device establishes its own point-to-point connection. This means that the communication between individual devices does not affect the achievable data rate of other devices.

1.5 The various RAID levels (Redundant Array of Independent Disks)

In general, a RAID group is referred as a "RAID array" or "RAID set". The various drives combined in the RAID set appear to the system as only one drive. A RAID set consists of at least 2 drives. The drives belonging to a RAID set are usually also called “members”. Further properties of the individual RAID levels can be found below.

1.5.1 Mirror mode (RAID 1)

The data is written (mirrored) to two or more drives in parallel by the RAID controller. The mirroring significantly increases both the availability of the data and its security. Since the controller can access several drives at the same time, the performance is noticeably improved by reading from the attached drives at the same time. If one of the drives should fail due to a defect, the remaining drives overtakes their function, so no data is lost. The defective drive can then be replaced. The data is then copied from the remaining, intact drives to the replaced drive using a so-called “rebuild” process, so that the data redundancy is restored again after this process has completed.



1.5.2 Mirror mode (RAID 1) variants

Although a RAID 1 or Mirror set is the simplest form of a RAID, various variants, which can also be combined with each other, provides interesting options for increasing performance and data security.

- Backup set

A special variant of a Mirror set is the backup set: here a Mirror set with two drives is created in such a way, that the mirroring is performed only once, and then the RAID set is automatically broke up and the target drive will be hidden from the operating system.

- Hybrid Mirror set

This variant is the combination of SSD and conventional hard drives. Since the drives involved in a Mirror set contains identical data and the controller automatically recognize the SSD as such, the controller prefers read accesses to the SSD. With simultaneous read access to the other drives, the SSD speed can even be exceeded.

Due to the automatic detection of SSDs, you do not need to pay attention to anything else when creating a hybrid Mirror set and only configure a Mirror set (as described in chapter 2.4.3.3).

- Mirror set with several secondary drives

Another variation is to configure the second drive of a Mirror set for regular exchange. In this way, you get the reliability of a data mirroring and you always have another drive with a full backup. The advantage is, that this backup drive can be connected to any controller and contains all data as well as the installed operating system and application programs.

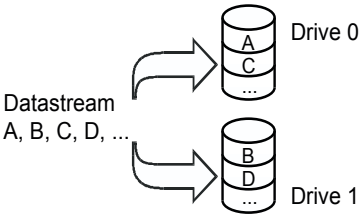
To create such a Mirror set with several secondary drives, first setup a Mirror set with two drives as described. After completing the configuration and a possible copy / rebuild process, shut down the system and replace the second drive with another one. Then power on the system again, invoke the controller BIOS and add the new drive to the Mirror set as a second drive using the "Add / Replace" function (see Section 2.4.5).

This further secondary drive will get the status "Rebuild" and will be synchronized by a rebuild process in the background, while you can continue working with the system as usual. Both secondary drives can now be exchanged at regular intervals (i.e. weekly), wherein the replaced drive will be automatically detected as "Rebuild" each time (without re-configuration), and will be synchronized in the background again by the rebuild process.

If necessary, further drives can be configured as Mirror secondary drives in this way, so different backup strategies can be implemented.

1.5.3 Stripe mode (RAID 0)

The data will be written to the drives alternately in blocks, whereby the size of each block is determined during the RAID configuration. By distributing the data to two or more drives and the ability of the controller to access two or more drives at the same time, the performance is significantly increased and the capacities are ideally summarized. The drives should be as similar as possible, otherwise the size and performance of the smallest drive will be used as a benchmark for the other drives. The disadvantage is, if one drive of the RAID set fails, the entire RAID set is affected.

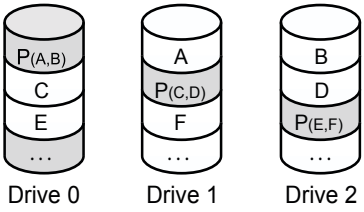


1.5.4 Mirror-Stripe mode (RAID 10, optional)

This is a combination of the two previously mentioned RAID types. The array consists of four drives. The data is written alternately in blocks (striping) on two drives, thereby increasing the performance. In order to increase data security, the data is mirrored at the same time to the other two drives, so that full data redundancy is guaranteed.

1.5.5 Parity-Stripe mode (RAID 5, optional)

In general, RAID 5 is considered to be the best compromise of data security, capacity utilization and performance. Like RAID 0, the data is distributed to the attached drives in fixed blocks of a certain size, but additional data blocks with parity information are alternately written to the drives. This has the advantage, that the capacity of a RAID 5 set is only slightly smaller than a RAID 0, and one drive can still fail. The performance of a RAID 5 set is limited only by the calculation of the parity data during write accesses. At least three drives are required for RAID 5.



1.5.6 Concatenation mode (JBOD, optional)

JBOD means "Just a Bunch of Drives" and describes the combination of several drives of different sizes to setup a single virtual drive, that can be addressed by one drive letter. The drives of the RAID set are concatenated in the selected order and their capacities are added. Thus, although there is no loss of capacity, there are neither advantages in terms of speed nor reliability. This type of RAID is therefore reserved for special applications.

2 Hardware configuration

2.1 Controller overview

Controller	UEFI BIOS	RAID 1 RAID 0	RAID 10	RAID 5	JBOD	Ports gesamt	Ports extern	Anschluss-Typ	PCI-Bus-Typ
DC-644e RAID	X	X	X	X	X	4	0	SATA 6G M.2 (NGFF)	PCI-Express 2.0 x4
DC-624e RAID	X	X	X	X	X	4	2	SATA 6G 6 GBit/s	PCI-Express 2.0 x2
DC-622e RAID	X	X			X	2	2	SATA 6G 6 GBit/s	PCI-Express 2.0 x2
DC-614e RAID	X	X	X		X	4	0	SATA 6G 6 GBit/s	PCI-Express 2.0 x1
DC-610e RAID	X	X			X	2	1	SATA 6G 6 GBit/s	PCI-Express 2.0 x1
DC-600e RAID	X	X			X	2	0	SATA 6G 6 GBit/s	PCI-Express 2.0 x1
DC-324e RAID		X	X	X	X	4	2	SATA II 3 Gbit/s	PCI Express x1
DC-310e RAID		X			X	2	1	SATA II 3 Gbit/s	PCI Express x1
DC-300e RAID		X			X	2	0	SATA II 3 Gbit/s	PCI Express x1
DC-4320 RAID		X	X	X	X	4	2	SATA II 3 Gbit/s	PCI-X
DC-4300 RAID		X	X	X	X	4	0	SATA II 3 Gbit/s	PCI-X
DC-3410 RAID		X	X	X	X	4	1	SATA II 3 Gbit/s	PCI
DC-154 RAID		X	X	X	X	4	2	SATA I 1,5 Gbit/s	PCI
DC-150 RAID		X				2	1	SATA I 1,5 Gbit/s	PCI
DC-133 RAID		X	X			2	1	UDMA6 133 Mbyte/s	PCI

2.2 Installation

In order to install the controller, you have to open the case of your computer: please refer to the manufacturer's warranty conditions in this context. Before opening the case, you must always switch off the computer and pull out the power plug! Please insert the controller carefully into a suitable free slot. Make sure, that the slot contacts fully engage in the slot of the mainboard and that the controller's mounting bracket is in contact with the housing as intended. Then you can screw the bracket to the housing.

2.3 BIOS update

The current BIOS version of your controller is available for download on our website www.dawicontrol.com at "Support / Downloads / SATA / IDE RAID". The actual BIOS file "BIOSxxx.BIN" (xxx = controller type) is located in the "\BIOS" directory of the respective driver package. You also need the flash tool DCFLASH.COM from the CD supplied or from our website. Please boot the system in DOS mode (no DOS window under Windows), the BIOS and DCFLASH must be in the same directory. Now run DCFLASH and follow the instructions on the screen. The existing BIOS will be automatically saved as "BIOS.BAK" file during flashing. By restarting the system, the new BIOS version is displayed and you can use any new features from now on.

The following additional parameters are optional:

/?	displays options and information about DCFLASH
/B	only backup the existing BIOS
/-B	disable automatic backup of the existing BIOS
/U	flash unconditional, even if the BIOS is already up to date

Please note, that the various controller-settings selected by "F10 Settings" will be reset to their default values by the BIOS update process.

Alternatively, the BIOS update can also be done under Windows using the "RAID Monitor", please refer to Chapter 3.5.3.

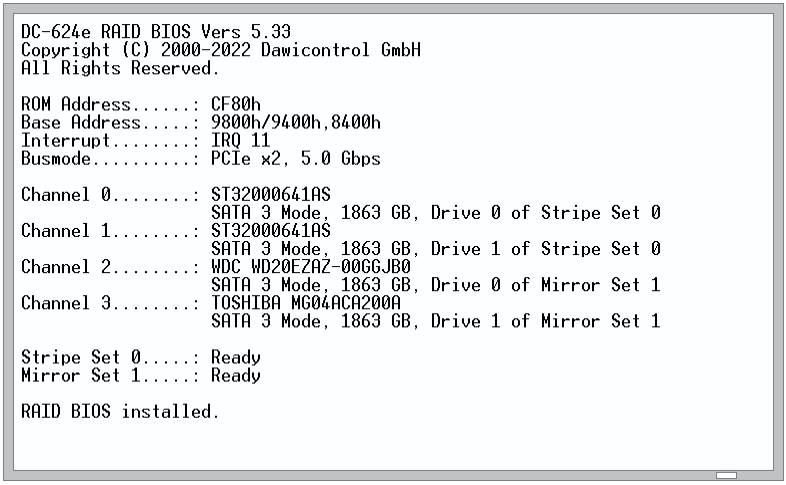
In case that the BIOS is not required or in order to save system resources, the BIOS can be disabled by turning off the boot function of the controller-settings, see refer to section 2.4.7.

2.4 RAID BIOS Setup

The RAID controller and the attached drives will be configured by the RAID Setup integrated in the controller BIOS. Here you can configure the various RAID levels, view information and perform other RAID set, controller or drive-specific operations.

2.4.1 Installation message

After installing the controller, the Dawicontrol RAID-BIOS installation message appears when your computer is started:



According to the boot settings of your system, the first line of the installation message shows the BIOS operating mode as "DC-... RAID BIOS Vers ..." when in conventional ("Legacy") mode, or "DC-... RAID ***UEFI*** BIOS Vers ..." when in UEFI mode.

Below this, the allocated system resources such as the BIOS address, I/O addresses of the ports and the assigned interrupt are displayed.

With certain controller types, additional the current busmode of the controller is also displayed with buswidth and busspeed. This may help to choose the most suitable slot for the controller.

Then the attached drives are initialized and displayed together with their port designation. In addition to the drive name, the selected SATA mode and capacity are shown. If the drive belongs to a RAID array, the drive number within the RAID (Drive ...) and the more detailed specifications of the RAID set are displayed in addition.

After all drives have been found, the detected RAID sets are verified for completeness and consistency and displayed on the screen, together with their determined status.

This status message has the following meaning:

Ready	The RAID set has been checked and is fully operational.
Drive Locations changed	One or more drives are no longer connected to their originally intended ports, but this has no influence on the function of the RAID set.
Rebuild	The drives of a Mirror, Mirror Stripe or Parity Stripe RAID set are not synchronized and must be rebuilded, i.e. in the RAID Setup. The RAID set is still ready for operation.
Reduced	A drive in a Parity Stripe set (RAID 5) is missing or not synchronized, the RAID set is currently operating without redundancy. The failed drive should be replaced and rebuilded as soon as possible in order to restore data redundancy.
Complete	The Backup set is completely synchronized.
Drive removed	The destination drive of a Backup set is locked and therefore protected against unintended access.
Incomplete	The creation of a Stripe, Mirror Stripe or Parity Stripe RAID set was interrupted; this can be continued in the RAID Setup.
Hidden	This RAID set cannot be accessd by the operating system and application programs. This status is used for Spare drives.
Broken	At least one drive is missing from this RAID set.
Invalid	The data structures of this RAID set are inconsistent or unknown and therefore they can no longer be processed or restored automatically. A manual data recovery maybe required.
Read only	During verification a serious problem was found and therefore the affected RAID set is write-protected. The data can be read in order to backup the data, but write-accesses to the RAID set are denied until the problem is solved.

If the installation message of the controller BIOS does not appear as described, then first check the correct installation of the controller in its slot. If this is ensured, then the settings of the system or the mainboard BIOS should be checked and, if necessary, corrected. To do this, please invoke the system BIOS and verify the advanced settings or the boot settings:

- With some systems the manufacturer logo is shown at start-up, which covers the installation message of the controller BIOS. In this case, disable the "Boot-Logo" option at the system BIOS.
- In addition, it may be necessary to enable the option "Adapter ROM Support" or "Legacy Adapter ROM Support".
- In systems with UEFI-BIOS there is usually a CSM menu ("Compatibility Support Module") within the boot settings, from where these settings are made.
- Furthermore in the CSM menu you can choose, whether booting should be done in UEFI mode (only possible with DC-644e, DC-624e, DC-622e, DC-614e, DC-610e or DC-600e RAID controllers) or in conventional ("Legacy") mode. In some cases it should also to distinguish between the different interfaces. This settings will determine the operating mode of the controller BIOS.
- In order to enable CSM support, with some systems it may be necessary to disable "Secure Boot" first. If "Secure Boot" cannot be disabled directly, this is often done indirectly by changing the operating system setting from "Windows UEFI Mode" to "Other OS" within the "Secure Boot" menu.
- If CSM support is not enabled in the system BIOS, normally the system will boot in UEFI mode. There are also pure UEFI systems without any CSM support and thus only boot in UEFI mode.

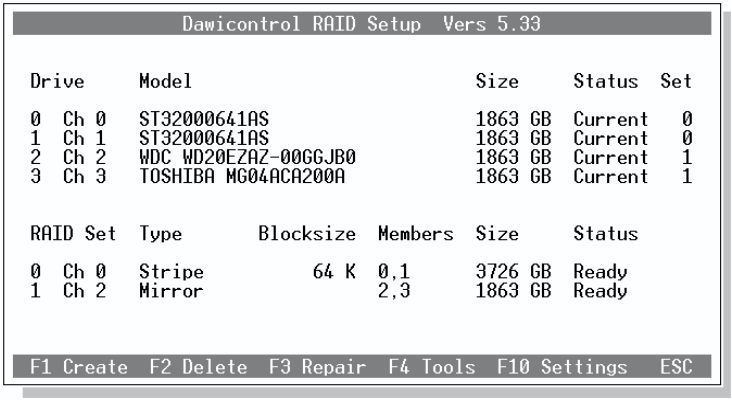
Unfortunately the terminology and the structure of the mainboard BIOS are not the same between the various systems and manufacturers, so the above terms should always be understood in a corresponding manner.

Afterwards you can invoke the BIOS-integrated RAID Setup by pressing the F4 key. In the case of UEFI systems, there is also an additional option of invoking the RAID Setup from the UEFI shell:

- Start the UEFI shell either directly from the mainboard BIOS (if possible) or from a storage medium, i.e. from a USB stick.
- Type "DRIVERS" [ENTER] or "DRIVERS -B" [ENTER] to display a list of the installed drivers on the screen.
- Then the controllers associated driver should be listed with its assigned ID, i.e.: "17B 00052203 B x - 1 1 Dawicontrol DC-624e RAID Driver", in this example "17B" would be the required ID.
- Now type "DRVCFG 17B -S" [ENTER] (replace "17B" with the specified ID) to invoke the RAID Setup.

2.4.2 RAID Setup main menu

If you have succesful invoked the RAID Setup, first in the upper half of the screen the attached drives are displayed and in the lower half the RAID sets, that have already been configured:



When the drives are listed in the upper part of the screen, the following parameters are displayed:

- Consecutive drive number, beginning with "0"
- SATA / IDE port designation
- Drive designation
- Capacity of the drive

If the drive belongs to a RAID set:

- RAID-Status of the drive
- Consecutive RAID set number to which the drive belongs

The RAID status of the drive has the following meaning:

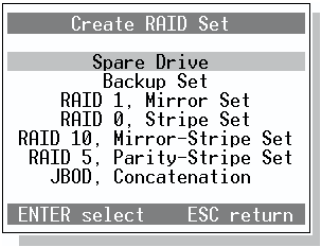
Current	the drive is ready for use and contains current data.
Complete	the backup set has been fully synchronized.
Rebuild	the data is not up-to-date, rebuilding is necessary.
Striping	the configuration of a stripe set was interrupted, performing of "Complete Stripe Set" is necessary .
Conflict	there is a conflict with the port assignment.
Removed	the drive has been removed from the RAID set.
Dropped	the drive was automatically locked.
Orphaned	the drive is no longer synchronous with its associated RAID set and has to be checked and manually added or removed from the RAID set.
None	no status, i.e. spare drive.
Corrupted	the RAID configuration data of the drive are invalid.

The available RAID sets are displayed in the lower area of the screen as follows:

- Consecutive RAID set number, starting with "0"
- Port designation which is assigned to the RAID set by the BIOS
- RAID-type
- Blocksize (only for stripe, mirror stripe or parity stripe RAID sets)
- Associated drives (see above drive numbers)
- RAID set capacity
- Status of the RAID set (see installation message)

With the keys F1, F2, F3, F4 and F10 or with the number keys 1, 2, 3, 4 and 0 the functions for creation, deletion, repairing and maintenance of RAID sets and drives as well as for controller configuration can be invoked, the ESC key exits the RAID Setup. All functions are selected with the arrow keys and the ENTER key, the ESC key always aborts the current function and returns to the previous selection.

2.4.3 Creating a RAID set (F1 Create)



Here a new RAID set can be created from scratch. At first the RAID type must be selected. You can choose between “Spare Drive”, “Backup Set”, “RAID 1, Mirror Set”, “RAID 0, Stripe Set”, “RAID 10, Mirror Stripe Set” (optional), “RAID 5, Parity Stripe Set”(optional) and “JBOD, Concatenation ”(optional) can be selected.

Basically, when creating a RAID set the data of one of the involved drives can be retained. To do this, the relevant drive must be selected as the first drive (source drive) when choosing the RAID drives. After all other drives are choosed, finally "Create Set and copy Data" must be selected in order to retain the data from the first drive and copy them to the RAID set. The detailed procedure is described in the following sections for the different RAID variants.

If you intend to retain the data from a drive to create a RAID set, at least 1 MB must be free at the end of the source drive's capacity. Therefore it may be necessary, to shrink the last partition of the drive before creating the RAID set, in order that at least 1 MB is free. This can be done under Windows using Disk Management or under Linux using the program 'gparted'.

Please consider, that copying the data on large drives can take a long time (approx. 100 to 500 GB per hour), depending on the controller type and the drives used. You can abort this process at any time by pressing the ESC key, and later resume or complete it, either manually using the "Rebuild / Complete Set" repair function (see chapter 2.4.5) or automatically by the driver under the respective operating system.

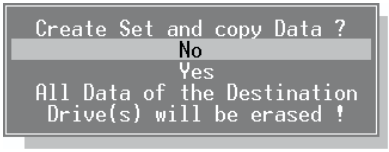
2.4.3.1 Creating a spare drive

Here you have to select the spare drive from the available drives and then confirm this by a "Yes" / "No" query. The selected drive will then be configured as a spare drive. From then on, this drive is no longer visible to the operating system and read / write accesses to this drive are no longer possible.

Basically, the spare drive remains shut down in normal operation, unless the "sleep mode" has been disabled for this drive in the controller settings. If a drive from a RAID set fails, the spare drive will be spun up if necessary, added to the RAID set and a rebuild process will be started. This spare drive must have at least the capacity of the smallest drive of the RAID set.

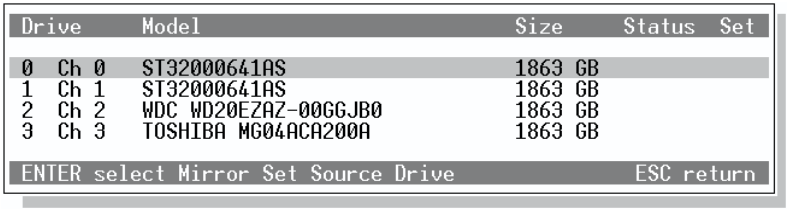
2.4.3.2 Creating a Backup set

To create the backup set, please select the “Source” and “Destination” drives from the available drives which the backup set should consist of. After you have made your selection, you will be asked for a final confirmation with a "Yes" / "No" query. Only now the RAID set will be created with the selected settings, or the operation will be canceled.

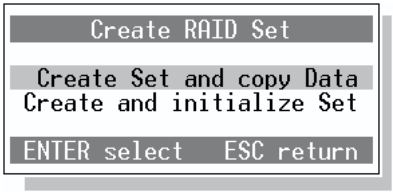


2.4.3.3 Creating a Mirror set (RAID 1)

First you have to choose the number of drives that the Mirror set should consist of. Usually a Mirror set consists of two drives, but three or four drives can also be used with some RAID controllers. Then you have to select the “Source” and “Destination” drives from the available drives.

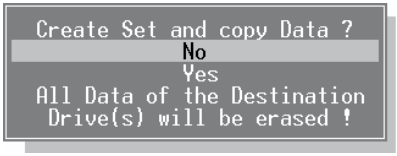


Then you have to determine, whether the data should be copied from the “Source” drive to the “Destination” drives (and thus any existing data of the “Destination” drives should be deleted), or whether you initialize the Mirror Set (and thus all data of the used drives should be deleted).



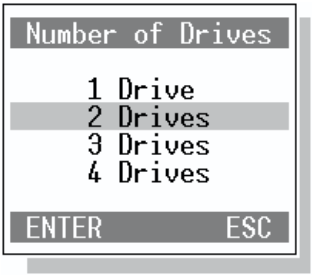
The capacity of a Mirror set always corresponds to the lowest capacity of the individual drives.
If you decide to copy the existing data from the "Source" drive, therefore the capacity of all "Destination" drives should match at least the capacity of the "Source" drive.

After you have made your selection, you will be finally asked for confirmation by a “Yes” / “No” query. Only now the RAID set will be created with the selected settings, or the operation will be aborted.



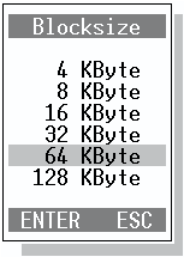
2.4.3.4 Creating a Stripe set (RAID 0)

At first, the number of drives and the blocksize must be specified; a Stripe set can consist of 2 - 4 drives.

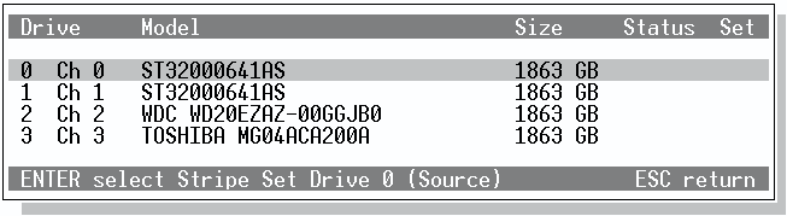


The optimal setting of the blocksize depends on usage of your computer: for database applications a smaller blocksize is recommended, but for video editing a larger blocksize is better.

The preset default setting is optimal for all standard applications and can be accepted by pressing the ENTER key.

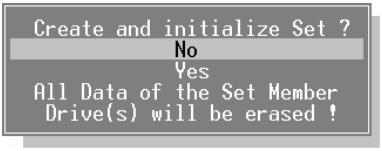


Then please select from the available drives the “Source” and the other drives, which should be included to the Stripe set:



At next you have to determine, whether the data should be copied from the "Source" drive to the RAID set (and thus the data of the "Destination" drives will be deleted), or whether you want to initialize the Stripe set (and thus the data of all drives involved will be deleted).

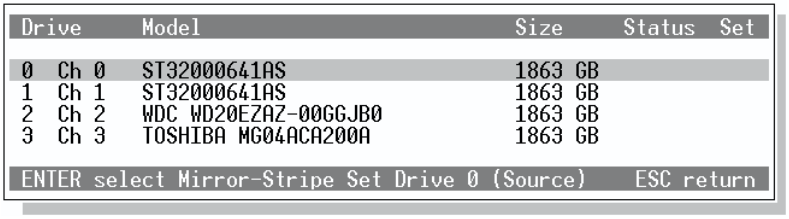
After you have made your decision, you will be asked for a final confirmation by a “Yes” / “No” query. Only now the RAID set will be created with the selected settings, or the operation will be aborted.



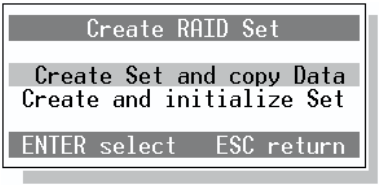
2.4.3.5 Creating a Mirror Stripe set (RAID 10, optional)

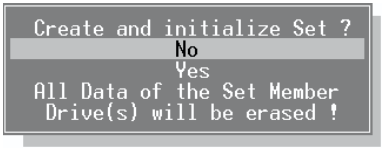
This RAID variant consists of the combination of a Mirror set and a Stripe set with two drives each, so a total of four drives. Drives 0 and 1 as well as drives 2 and 3 each forms a Stripe set. With these two Stripe sets, a Mirror Stripe set is formed by mirroring drive 0 and 2 as well as drive 1 and 3. Similar like creating a Stripe set, at first the blocksize must be specified with the same considerations.

Then the “Source” and the additional drives should be selected from the available drives, from which the Mirror Stripe set should consist.



Then you have to determine, whether the data should be copied from the "Source" drive to the RAID set and thus the existing data on the other drives should be deleted, or whether you want to initialize the RAID set (and thus delete the data of all drives involved).





After you have made your selection, you will also be asked for the last time to confirm with a “Yes”/“No” query. Only now is the RAID set will be created with the selected settings or the operation will be canceled.

2.4.3.6 Creating a Parity-Stripe set (RAID 5, optional)

Similar like the creation of a Stripe set, at first you have to select the number of drives and the blocksize. Regarding the blocksize, the same considerations apply to a RAID 5 as to a RAID 0 or RAID 10; however, because additional blocks with parity data will be generated during write operations, we recommend accepting the default value by pressing the ENTER key.

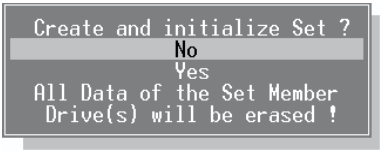
Then select the “Source” and the additional drives from the available drives, from which the Parity Stripe set should consist.

After the drive selection you have to determine, whether the data should be copied from the "Source" drive to the RAID set and thus the existing data on the other drives should be deleted, or whether you want to initialize the RAID set (and thus delete the data of all drives involved).

If SSD or SMR-HDD drives are involved, which do not support deterministic read after a TRIM command (DRAT), they have to be erased by the "Secure Erase" command or by the "Erase Drive (Command)" (see chapter 2.4.6) in order to reset their internal memory management. Otherwise it would not be possible to ensure the necessary redundancy.

In this case a corresponding error message will pop-up and the configuration can be continued, after the affected drives have been successfully erased and resetted (see chapter 2.4.3.10).

After you have made your selection, you will also be asked for the last time to confirm with a “Yes”/“No” query. Only now is the RAID set will be created with the selected settings or the operation will be canceled.



2.4.3.7 Creating a Concatenation set (JBOD, optional)

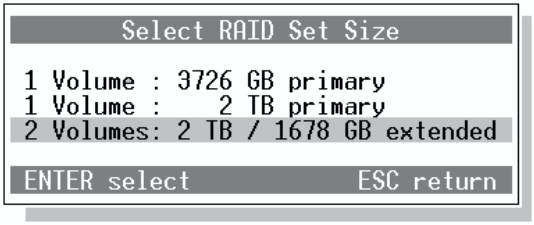
This selection combines 1 to 4 drives into one drive seen by the operating system. No RAID set in the real sense is created here, but the drives are chained together and their capacities are added. This means, that the drives are written to one after the other. During setup, the number of drives must be specified and the respective drives selected.

2.4.3.8 Special features of capacities more than 2 Tbytes

All RAID controllers from Dawicontrol can handle drives and RAID sets with high capacities of more than 2 TB without any problems, but this does not apply to all operating systems. In example, Windows XP does not recognize drives with a capacity of more than 2 TB. With the successor versions, either only the first 2 TByte can be used, or another type of partitioning (GPT instead of MBR) is required. But then there are restrictions when using it as a boot drive: Windows is able to boot from a GPT partition only in UEFI mode.

Normally, the RAID set should be configured with its total capacity as one logical drive, just as this would be done automatically with a capacity of less than 2 TB.

In order to work around the above mentioned restrictions when using older versions of Windows and to enable the use of the entire capacity, the RAID capacity can either be limited to 2 TByte during the configuration or divided into several logical drives or "volumes", which appear to be physically independent to the operating system:



In this example the first logical drive "primary volume" would be configured with a capacity of 2 TByte (2048 GByte) and the second logical drive "extended volume" with the remaining capacity of 1678 GByte. These logical drives appear to the operating system as physically independent and therefore enable the use of the entire capacity.

This feature is basically only available for RAID sets, but it can also be used for single drives by configuring them as JBOD with only one drive.

Please consider, that such configured "extended volume" can only be accessed by a Dawicontrol RAID controller, even if it is a single drive or a drive of a Mirror set (RAID 1).

2.4.3.9 Special features of drives with 4K native (4Kn) format

Originally, all common hard disk drives had a fixed sectorsize of 512 bytes as smallest addressable unit (512n format). Some time ago, almost all hard disk manufacturers have switched to sectorsizes of 4 KByte, whereby the hard disk continues to emulate 512-byte sectors (512e format) in relation to the controller and the operating system: eight 512-byte sectors are internal combined by the hard disk to a 4 KByte sector. It is obvious, that this method can cause slowdowns of write accesses, if the datablocks to be written are not at a 4K boundary, or their size is not a multiple of 4 KByte. Nevertheless, for compatibility-reasons this 512e format is currently used by the majority of all commercially available hard disk drives.

With the so-called 4Kn format, the hard drive indicates the actual sectorsize of 4 KByte to the controller and operating system, which makes it necessary that the BIOS, the operating system and especially the controller can handle this sectorsize: all Dawicontrol RAID controllers are supporting 512n, 512e and 4Kn drives without any restriction.

Just like an individual drive, a RAID set must also indicate its underlying sectorsize to the BIOS and the operating system. If only drives with a sectorsize of 512 bytes (512n and 512e format) are used, a sectorsize of 512 bytes will be also used for the RAID set. With one or more 4Kn drives in the RAID set, a sectorsize of 4 KByte will be used.

Therefore it is not possible, to use the data from a drive with 512-byte sectors to create a RAID set with 4 KByte sectorsize, as these would no longer be individually addressable due to the coarser 4 KByte granularity, but vice versa it will be possible without problems.

Also for this reason, a 4Kn drive cannot be used as a replacement drive in a RAID set with 512-byte sectorsize, but the reverse is also possible without any problem.

In such cases, the controller BIOS will issue a corresponding error message:

The sectorsize used by the RAID set is reported in the associated metadata under "Logical Sectorsize", see chapter 2.4.6.

Furthermore, it should be considered that the conventional (legacy) BIOS interface will only support sectorsizes of 512 bytes, so booting from a 4Kn drive or from a RAID set with one or more 4Kn drives will only be possible in UEFI mode. However, an operation as pure data drive is possible without any restrictions.

2.4.3.10 Special features of SSD and SMR-HDD drives

In general, SSD drives and SMR (Shingled Magnetic Recording) hard disk drives are treated by the controller like conventional hard disk drives, but when using them (i.e. in a RAID 5 set), various special features should be taken into account.

SSDs combine their memory cells usually in pages of a size of 4 or 8 KByte. A page can be read unlimited times, but must be erased before it can be written again. The smallest erasable unit of a SSD is a block, which in turn usually consists of 128 or 256 such pages.

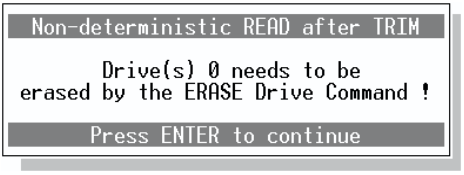
So when writing a single sector, the entire block would have to be read, erased and rewritten. In order to accelerate this process, SSD drives internally are managing a pool of already erased pages with the help of special algorithms like over-provisioning, garbage collection, a.s.o., which could be directly rewritten and thus could replace the originally addressed page.

Furthermore, the flash memory cells of a SSD cannot be erased and rewritten unlimited times, therefore SSD drives uses so-called wear-leveling methods in order to evenly distribute the write accesses over their total capacity.

The TRIM command was introduced to support SSD drives in these tasks: the operating system informs the SSD about areas that no longer contains valid data, i.e. when a file is deleted or a drive is formatted. This also applies to hard disk drives which are using the SMR method and also support the TRIM command. The respective drive can then erase these areas and prepare them for rewriting.

When reading "TRIMmed" areas, a distinction is made between two variants: deterministic reading after trim (DRAT) and non-deterministic reading. In the first case, always the same data is read by different accesses (i.e. zeros), in the second case, different data can be read. For this reason, the controller will not use TRIM commands for drives without DRAT support in a RAID 5 set, as otherwise the necessary redundancy cannot be achieved.

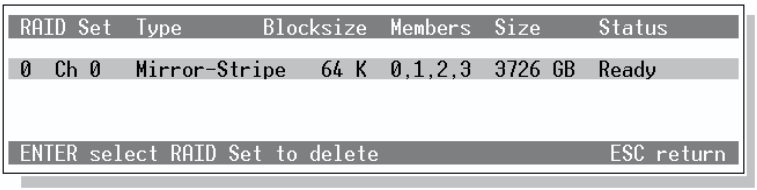
Furthermore, before creating a RAID 5 set, SSD or SMR-HDD drives without DRAT support that have been already in use must be erased by "Erase Drive (Command)" (see chapter 2.4.6) in order to reset their internal memory management. In these cases, the controller BIOS will issue a corresponding message:



In this regard, SSD and especially SMR-HDD drives without DRAT support are only suitable to a limited extent for use in a RAID 5 set, but there are no restrictions for all other RAID levels or for use as individual drives.

Since a SSD drive achieves its original maximum write speed by resetting it via "Erase Drive (Command)", this is also recommended before each new use, depending on the amount of data written so far.

2.4.4 Deleting a RAID set (F2 Delete)

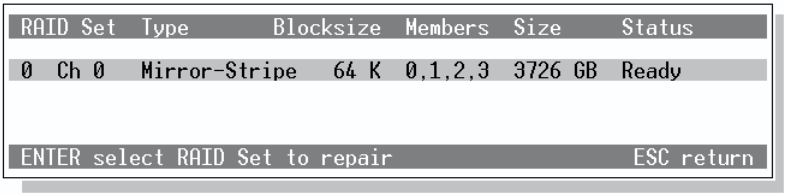


You can use this function to delete an existing RAID set. Depending on the type of the RAID set, the stored data will be retained or will be irretrievable erased:

- when deleting a Mirror set, only the RAID configuration data and an "extend volume" that may exist (see chapter 2.4.3.8) are deleted. Then you can use the drives of the original RAID set, each with the same content.
- when deleting a Stripe set, Mirror Stripe set, Parity Stripe set or a JBOD or concatenation set, the data of the RAID set will be irretrievable deleted, because it was distributed across the involved drives and therefore the individual drives would only contain incoherent data fragments. The RAID configuration data will be deleted and the partition tables of the affected drives will be reinitialized.
- when deleting a spare drive, only the RAID configuration data will be deleted. The drive is then available again with its original data.

In order to make sure, you will be asked by a “Yes” / “No” query (“Delete RAID Set?”) before the selected RAID set will be finally deleted. Then the RAID set will be deleted or the operation will be aborted.

2.4.5 Repairing a RAID set (F3 Repair)



Various functions for repair and maintenance are available from here. At first, the RAID set should be selected to which the following functions should apply. Then you can choose between:

- Update Drive Locations
- Add / Replace Drive
- Remove Drive
- Rebuild / Complete Set
- Split Mirror-Stripe Set

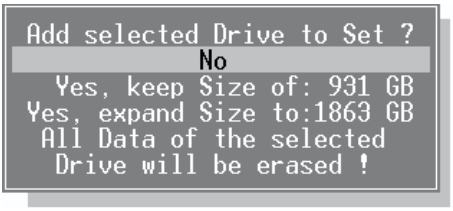
1. Update Drive Locations:

After changing the drive connections, the configuration data of the RAID set can be updated here. The ports to which the drives of a RAID set are connected are stored in the configuration data. Among other things, the later assignment of the drive letter results from the position of the first drive in a RAID set.

2. Add / Replace Drive:

Here you can add or reintegrate replaced or orphaned drives into a RAID set. You can also expand a Stripe set with two more drives to a Mirror Stripe set or add further drives to a Mirror or JBOD set. With the exception of the JBOD set, the new drives must have at least the capacity of the smallest drive in the respective RAID set.

In case that the capacity of the RAID set can be expanded by replacing with a larger drive, you will be informed by the following window and you can choose, whether the previous capacity should be retained or increased:



3. Remove Drive:

This function can be used to remove failed drives or drives that are no longer required from a RAID set. Furthermore, even the removal of currently used drives (i.e. for the purpose of replacement) from a redundant RAID set possible, as long as the data of the RAID set remains consistent.

4. Rebuild / Complete Set:

With Backup, Mirror, Mirror Stripe or Parity Stripe RAID sets, this function can be used to restart a rebuild process for data reconstruction or to continue after a previous interruption. The rebuild process can be used in case of a “Rebuild”, “Removed” or “Dropped” status of the RAID set. In case of an "Incomplete" status, the creation of a Stripe, Mirror Stripe or Parity Stripe RAID set from existing data can be continued after a previous interruption.

5. Split Mirror-Stripe Set:

This function splits an existing Mirror Stripe set into two Stripe sets. The two resulting Stripe sets are then available independently of each other with the same content.

2.4.5.1 Replacing a failed RAID drive

Basically, the failure of a single drive of a RAID 1, RAID 10 or RAID 5 will be tolerated. This means, that the data structure of the RAID set is still retained and the data from the failed drive can be restored from the remaining drives.

If the failed drive is still recognized and can be accessed, at first it can be removed from the RAID set using the "F3 Repair / Remove Drive" function, so that its data can be erased later by using one of the two "Erase Drive" functions (see chapter 2.4.6), but this is not necessary for the actual exchange and is left to your discretion.

To replace the drive, shut down the system and replace the failed drive with a new one with at least the capacity of the smallest drive configured in the RAID set. Turn the system on again and invoke the controller BIOS: the new drive is then listed as single drive and must now be added to the RAID set.

Invoke "F3 Repair" and select the concerned RAID set. Then choose the "Add / Replace Drive" function and select the newly connected drive as the new RAID drive. Warning: all data of this drive will be irretrievably deleted.

After the mandatory confirmation, the new drive will be added to the RAID set and marked with the status "Rebuild". At the same time, the status of the RAID set will change from "Broken" or "Reduced" to "Rebuild".

As the last step, the data of the new RAID drive must be reconstructed using a rebuild process. This can be done either immediately afterwards by the "Rebuild / Complete Set" function, or automatically in the background after a restart under Windows, while you can continue working with the system.

Depending on the capacity of the RAID set, this rebuild process can take several hours. In both cases, however, the rebuild process can be interrupted or canceled without having to start all over again, this means that the rebuild process will continue after an interruption at this point.

After the rebuild process has been completed, the status of the new drive changes from "Rebuild" to "Current" and status of the RAID set changes from "Rebuild" to "Ready": redundancy has been restored and the RAID set is fully operational again.

2.4.6 Backup and maintenance (F4 Tools)

By pressing the F4 key, various functions for maintenance and backup are provided for both individual drives and RAID sets:

1. Create RAID Image

This function creates a sectorwise copy of a RAID set onto a single drive connected to the same controller. The capacity of this drive must correspond at least to the RAID capacity and this drive must not belong to a RAID set itself. First you have to select the RAID set from which the image should be created, then the "Destination" drive has to be selected.

After a final "Yes" / "No" query, the copying process begins, thereby all data of the selected "Destination" drive will be overwritten.

In order to identify the image drive and the image size, the drive is then marked as a "Contiguous" RAID set with the corresponding RAID size. Any division into "Volumes" will be also taken over.

The image created in this way can be restored later at any time by using the "Restore" function, or the image drive can be also connected directly to any other system in order to access the data.

2. Restore RAID from Image

This function copies the data sectorwise from a single drive to a RAID set operated with the same controller. First the "Source" drive has to be selected, this can be an image drive that was created in the manner described above, or can be also any other drive whose data should be copied to a RAID set. In this case, a corresponding notification will appear.

Then the "Destination" RAID set, to which the image should be copied, have to be selected. The capacity of the RAID set must at least correspond to the size of the image or the capacity of the "Source" drive.

After a final "Yes" / "No" query, the copying process begins, thereby all data of the selected "Destination" RAID set will be overwritten.

3. Clone Drive to Drive

This function copies one drive sectorwise to another and is therefore ideally suited to transferring an existing system to a new drive. The "Source" and the "Destination" drives must be selected one after another. The capacity of the "Destination" drive must at least match the capacity of the "Source" drive. After a security query, the copying process will begin and thereby all data of the "Destination" drive will be overwritten.

4. Report Drive Metadata

This function displays the RAID configuration data of each drive, that belongs or has been belonged to a RAID set. These information can be helpful in case of an eventually RAID recovery.

5. Erase Drive (Overwrite)

With this function, the data of drives that are no longer required can be completely and safely erased. After the mandantory security query, the selected drive will be overwritten sector by sector with random and non-reproducible data. All data of the drive will be irretrievably deleted. Since the entire available capacity of the drive is rewritten, for SSD drives we recommend using the function described below instead.

Because only single drives can be operated by this function, RAID drives should be removed from the respective RAID set, or the affected RAID set should be deleted.

6. Erase Drive (Command)

As with the previous function, the data of drives that are no longer required will be completely erased, but in this case the "Secure Erase" command is performed by the drive itself, comparable to "Low-Level" formatting. In contrast to sectorwise overwriting, the hidden reserved sectors are also taken into account in this way.

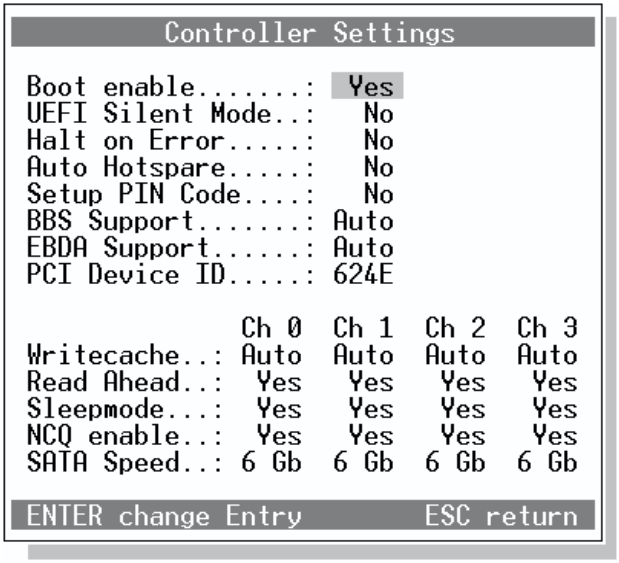
This method is particular preferable for SSD drives, which are constantly reorganizing their sector assignment for reasons of optimization. Another advantage of SSDs is that the internal memory management of the drive will be reset and the drive can achieve its original write speed again.

With so-called Self Encrypting Drives (SED), the drive will only change its internal key and the process is ended remarkably quickly. If it is ensured, that the original key cannot be accessed any longer and that there is no manufacturer master key, it will be either impossible to restore the data.

In case of doubt, both methods for data erasion can also be used in combination by using them one after another.

2.4.7 BIOS and drive settings (F10 Settings)

By pressing the F10 key, several basic settings for the BIOS and the drives can be accessed:



- Boot enable: if "Yes", the BIOS of the RAID controller will be installed in the so-called upper memory area and thus enables the system to boot from the controller. If this is not necessary, then this can be set to "No" to hide the BIOS again, after the drives have been initialized and checked, in order to save memory space in this area. The BIOS will then be deactivated, but it still appears on systemstart and can be invoked for configuration without any restriction.

- UEFI Silent Mode: if necessary, all messages from the controller BIOS can be suppressed in UEFI mode. You can still invoke the controller RAID Setup by pressing the F4 key at the right moment or from the UEFI shell. We recommend using this function only when operating single drives, in order not to miss a possible problem with a RAID set.

This function cannot be combined with the "Halt on Error" option below.

- Halt on Error: in case that a problem is detected during initialization of the controller and verification of the attached drives and RAID sets, the boot process will be interrupted and it will be asked to confirm by pressing the F1 key:

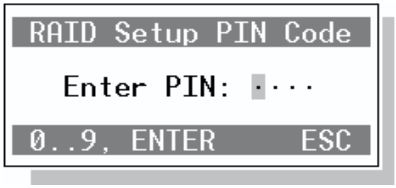
Press F1 to continue, F4 to enter RAID Setup...

- Auto Hotspare: (hotplug-capable controllers only) an unpartitioned drive connected via hotplug to the running system is treated as a replacement drive for an incomplete but rebuildable RAID set. If its capacity is sufficient and no existing partition was recognized, the newly connected drive will be automatically integrated into the concerned RAID set and a rebuild process will be started.

Warning: in this case all data of this drive will be irretrievably overwritten or erased without any further request.

If this function is disabled, only drives configured as spare drives will be used as RAID replacement drives.

- Setup PIN Code: access to the controller BIOS can be restricted by a four-digit secret number. To make sure, you must enter it twice. If you forget the PIN, the BIOS must be reflashed.



- BBS Support: the term BBS means "BIOS Boot Specification" and describes the method used by the controller to install and integrates drives and RAID sets to the system. By the "Auto" setting, the controller automatically detects whether the system BIOS supports BBS. It only makes sense to change this setting in case of compatibility problems. This setting applies only when operating in conventional (“Legacy”) BIOS mode.

- EBDA Support: the term EBDA means "Extended BIOS Data Area" and represents a BIOS memory management procedure. Here it will be determined, whether the controller should use this procedure to allocate its own memory space. By the "Auto" setting, the controller will detect this automatically; this setting should only be changed if there are compatibility problems. This setting applies only when operating in conventional (“Legacy”) BIOS mode.

- PCI Device ID: for some controllers, the PCI ID has been changed during development to improve compatibility. If this causes issues after a BIOS update of the controller, you can switch back to the previous ID here. However, it is recommended to keep the default value unless necessary.

- Writecache: determines the use of the writecache of the respective drive. By the "Auto" setting, the writecache will be controlled by the operating system in accordance with the setting of the respective drive in the device manager. With the setting "Yes" or "No" this is done independently of the operating system and exclusively by the controller. Windows Server operating systems sometimes disables the writecache for security reasons, which is often perceived as disadvantageous due to the resulting slowdown.

- Read Ahead: here the predictive reading of the respective drive will be enabled or disabled. Disabling this setting for conventional hard drives usually causes a slowdown and is therefore not recommended; the behavior of SSD drives is not uniform.

- Sleepmode: the support of the standby mode of the respective drive can be set here. Spare drives in particular remain switched off with the setting "Yes" and are only spun up when required.

The use of the sleepmode for SSD drives is controversial, as the energy savings are only marginal and SSDs are using the inactive time for internal reorganization and optimization tasks.

- NCQ enable: activates the so-called "Native Command Queuing", which enables the respective drive to process up to 32 commands at the same time. This option is not available for all controller types.

- SATA Speed: setting the maximum data transfer rate for each port. Since the controller and drive automatically negotiate the best possible value, this setting can usually be left at the highest possible value. Problems caused by unsuitable or inferior SATA cables or additional connections when using drive cartridges, could make it necessary to reduce the transfer rate. This option is not available for all controller types.

If you have made any changes to the settings, you must either confirm the new settings, or discard the changes when exiting the menu.

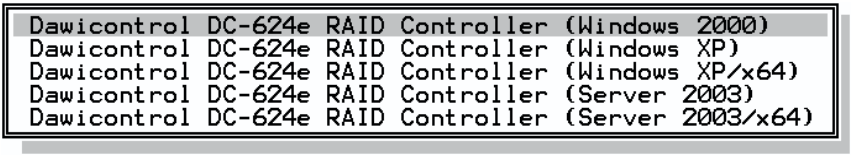
3 Installation under Windows

For the new installation of Windows 2000, XP and Server 2003 an additional driver disk is needed, you can create this using the supplied CD-ROM: just boot from the CD-ROM and follow the instructions on the screen. You will need a 3.5" floppy disk, it should not contain any data because it will be formatted during the copy process.

When installing later Windows versions (Windows Vista and later) you can load the drivers directly from the CD or another storage medium, also as well as if you want to install your controller later to an already running system.

3.1 New installation of Windows 2000, XP and Server 2003

- Create a driver disk (see above)
- Boot from the Windows CD or DVD.
- At the beginning of the installation, Windows Setup will prompt you to press the "F6" key if you want to install additional drivers for SCSI and RAID controllers. To install the driver of your controller accordingly, press "F6".
- After Windows Setup has loaded its standard files and drivers, you will be asked to specify additional mass storage controllers.
- Now insert the driver disk you have created and select the appropriate operating system from the menu using the arrow keys.

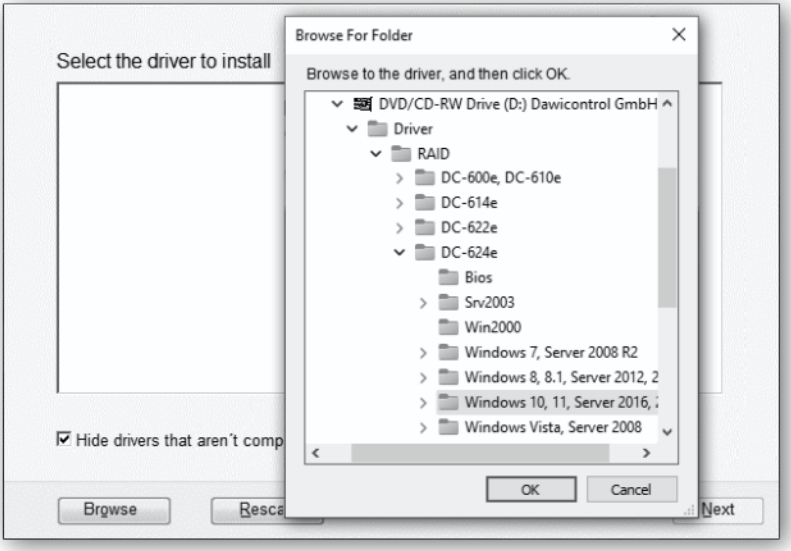


- Then the driver will be loaded and the drives and RAID sets attached to the controller will be available for the installation.
- Now continue with the installation of Windows as usual.

3.2 New installation of Windows Vista and later

For the new installation of Windows Vista, Windows 7, 8.x, 10, 11 and Server 2008, 2012, 2016, 2019, 2022 as well as their successor versions, a driver disk is no longer required; instead of, additional drivers can be installed directly from the supplied CD.

- Boot from the Windows DVD. Please note, that with UEFI systems the boot mode (UEFI or Legacy) of the Windows DVD must match the boot mode of the controller. If you install Windows with an USB stick, the same applies to its boot mode. Otherwise the installation cannot continue after the first restart.
- At the beginning, Windows Setup enables the installation of additional controller drivers by the "Load driver" button. Insert the driver CD and select the appropriate directory there; the directories of the CD are named according to the controller type and the respective Windows version.
- Please select just the parent directory of the corresponding version of Windows, the selection between the 32- and 64-bit version will be done automatically.



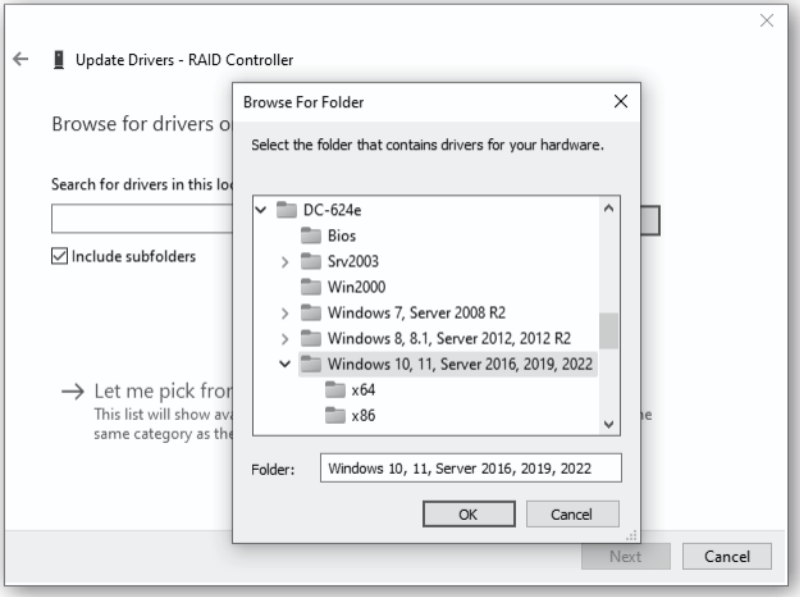
- Then Windows will load the driver and thereby will gain access to the drives and RAID sets attached to the controller.
- Insert the Windows DVD again and continue installing Windows as usual.

3.3 Installation to an existing system

If the RAID controller is installed into an existing system, the driver software will be installed by the Windows Device Manager or the new Hardware Wizard. The procedure required for this is very similar for all Windows and Windows Server versions.

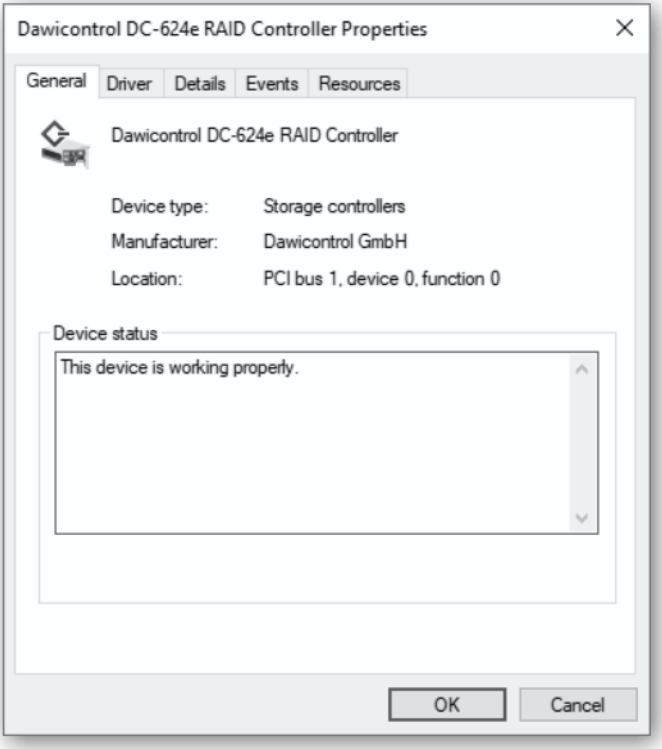
After you have installed the controller and started the system, Windows will recognize an initially unknown RAID controller as a new hardware component. Start the Windows Device Manager, select the new unknown RAID controller and then select "Update Driver".

- Do not let the Device Manager search for drivers automatically, instead of insert the supplied CD and use the "Browse" function to select the directory with the driver files on the CD. The directories of the CD are named according to the controller type and the respective Windows version. In case of Windows Vista or later please select just the parent directory of the corresponding Windows version, the selection between the 32- and 64-bit version will be done automatically.
- With older 64-bit Windows versions prior to Windows Vista you still have to select the respective x64 subdirectory. This is because of different processing of the installation scripts of the various Windows versions.



- Then click the "OK" button and confirm the security queries, the software for the Dawicontrol RAID controller will now be installed.
- After you have completed the process and closed the Device Manager, you may have to restart your system.

Finally you can verify the correct installation by checking the section "SCSI and RAID Controller" or "Storage Controller" in the Device Manager, depending on the Windows version: a "DC-XXXX RAID Controller" should be listed there. If the RAID controller is not listed there, please refer to chapter 5.2 “RAID troubleshooting” in this manual.



Now you can partition and format the RAID set or the attached individual drives as usual by following the instructions of the operating system on the screen.

Note: If you would like to attach your boot drive with the Windows system from another controller to the Dawicontrol RAID controller, you must first install the driver software before you change the connection of the drive!

3.4 Update driver software

The driver software will be permanently improved and made available for download. The least recent version is available at "Support / Downloads / SATA / IDE RAID" on our website "www.dawicontrol.com". From there, download the driver package according to your controller, unzip it into a suitable directory and then proceed as follows:

- Select the controller in the device manager and choose "Update driver". Select the manual search and do not automatically search for the supposedly best driver.

- Then provide the directory path using the "Browse" function.

- Then process the driver installation procedure as described in the previous chapter.

Depending on the controller type and Windows version in several cases a driver for the controller is already installed automatically, which is named related to the chipset manufacturer. In this case, we recommend replacing the automatically installed driver with the controller related driver supplied on the CD, as otherwise not all functions and features are guaranteed, as well as the RAID monitor and the e-mail notification will also not being supported.

Because these automatically by Windows installed drivers cannot easily be updated or replaced by a differently named driver from a third-party manufacturer, a slightly different procedure is necessary in this case:

- First select the controller in the Device Manager and choose "Update driver". Select the manual search for a driver as described above.

- From there, select the second option, which is described as "... select the driver to be installed myself" or "...select from a list of device drivers on my computer", depending on the Windows version.

- Then select "Have Disk" and use the "Browse" function to provide the drive and the directory path. The directories of the CD are named according to the controller type and the respective Windows version.

- Now proceed with the driver installation as described in the previous chapter.

3.5 The "RAID Monitor" user interface

The graphical user interface RAID Monitor enables you to monitor the attached drives and RAID sets during their operation by several configurable levels, both at the local computer and over the network, as well as via the Internet by the e-mail notification function.

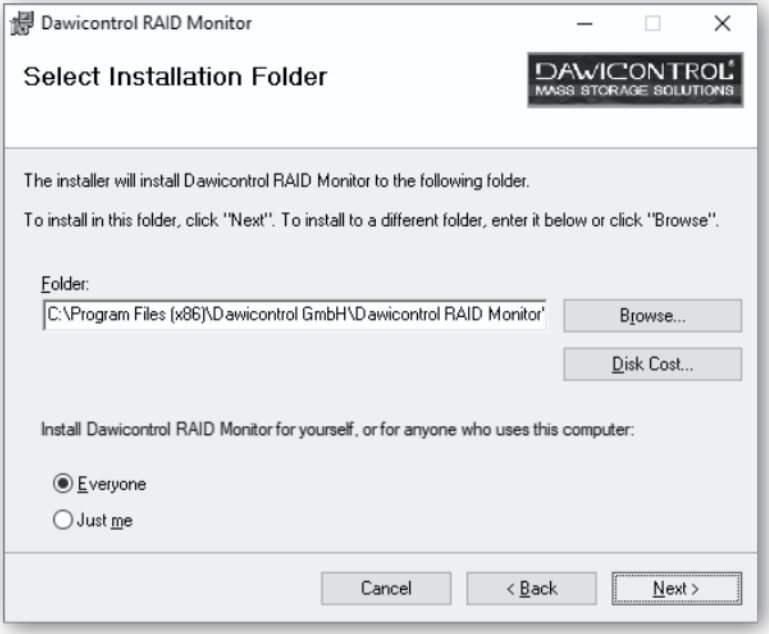
The RAID monitor consists of two components: the application program with the graphical user interface (GUI) and an additional service program, which processes the e-mail notifications and enables communication between the driver and the GUI.

3.5.1 Installation

To install the RAID Monitor, change to the "\Software\RAID Monitor" directory of the supplied CD and run the "RAIDmonitorSetup" installation program from there.

Then follow the instructions of the program on the screen. If the monitoring should be performed within a network, the installation must be done to the system with the RAID set and the controller, and on each system from where the monitoring should occur.

Please note that administrator rights are required for the installation.



3.5.2 Program start

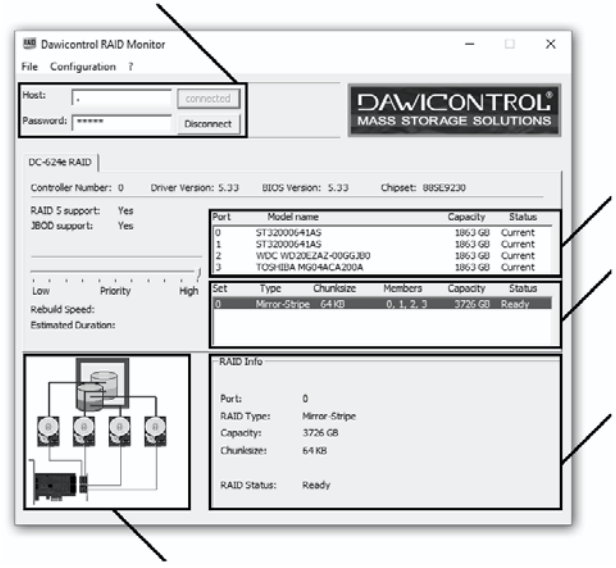
After installation, the RAID Monitor can be started from the startmenu entry "Start / Programs / Dawicontrol / RAID Monitor". In the following window you must first establish a connection to the utility by entering the host name and password.

The default entry for "Host" is a dot (means "localhost") and the default password is "admin". These values should be replaced if the access will be done via a network.

Then are the installed controllers, the attached drives and the RAID sets configured from them are displayed.

If there are several controllers, they are displayed as tabs in the upper area of the screen; by clicking on them, the drives and RAID sets attached to the respective controller as well as the properties are displayed.

Connection settings of the service program



Attached drives

Configured RAID sets

Additional informationen regarding the attached drives respectively the configured RAID sets

Graphic illustration of the controller and the attached drives resp. the configured RAID sets

Multiple controllers are displayed as tabs. After minimizing the program, only one icon is visible in the task bar; clicking on it will restore the window .

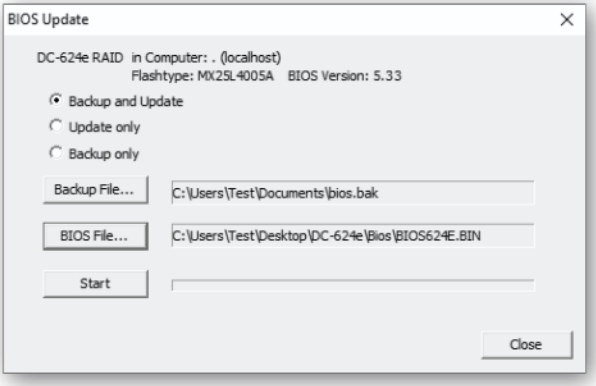
3.5.3 Configuration

At the menu entries there are further setting options that can be used for individual configuration:

File:

Show Error Log - a window will be opened and will list errors and events registered at register level; this information can be helpful for troubleshooting.

BIOS Update - updates the controller BIOS:



The BIOS of the controller can either be saved to a file and / or updated. After selecting the files, the previously selected process will be started by clicking the "Start" button and will be indicated by the progress bar.

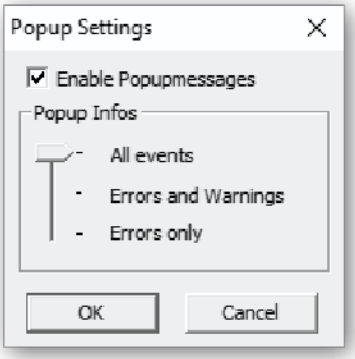
You can download the latest BIOS version from our website "www.dawicontrol.com" at "Support / Downloads / SATA / IDE RAID". From there, load the driver package of your controller. The BIOS file "BIOSxxx.BIN" (xxx = controller type) is located in the "\BIOS" directory.

Please note, that the various controller-settings selected by "F10 Settings" will be reset to their default values by the BIOS update process.

Exit - exit program.

Configuration:

Popup - Enabling and configuration of error and event notifications by popup windows:



Here you can select whether and what kind of messages should be enabled.

Email - Enabling and configuration of email notifications. The following entries are requested: recipient address, sender-name (free selectable), username and password of the sender's e-mail account, name of the outgoing mail server (i.e. smtp.servername.com) and bootup messages (sends a status report each time the system is booted).

Log File - Enabling and configuration of the log file: detected errors and events are saved to a file. Please note that this file may be at the remote system. Furthermore, this file should not be located on the RAID set itself, because in case of a serious error logging may not be possible any more and could cause further problems.

Password - Changes the password for connecting with the service program, the default password is "admin".

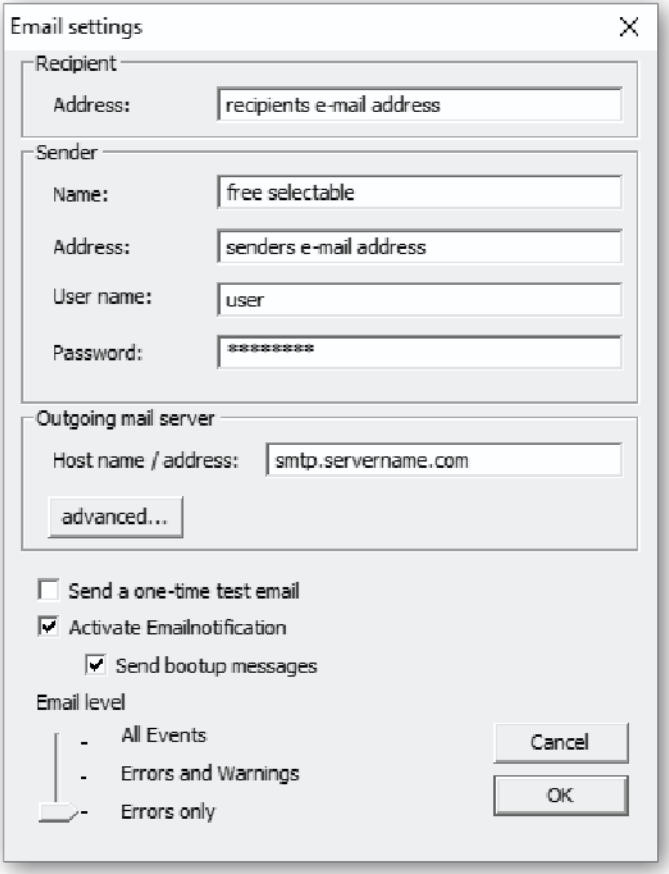
Autoconnect - Enable / disable automatic connection after program start.

Start minimized - After starting the program, only an icon appears in the Windows info area.

3.5.4 Email configuration

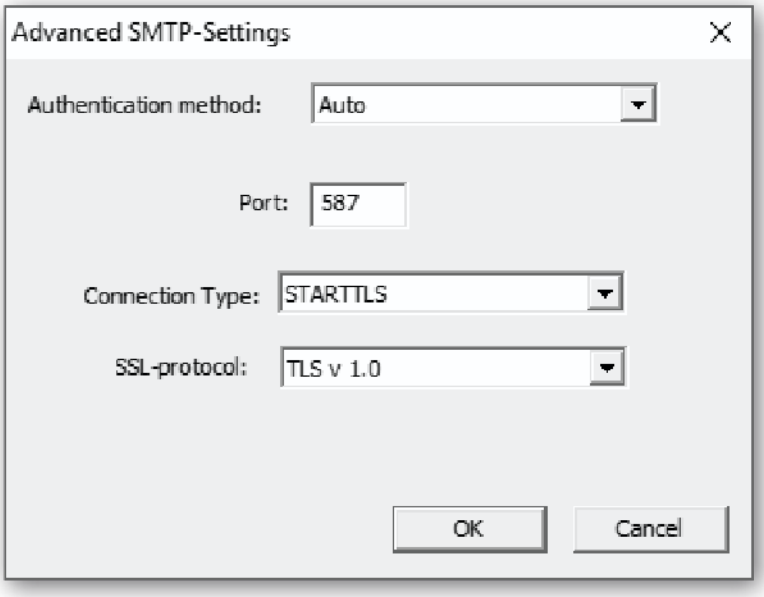
By this feature you can send notifications of errors and events to any email address; if several email addresses are to be entered, they must be separated by semicolons. Please note that the emails are sent by the service program, so possibly by the remote system.

The configuration is similar like an email program. In addition to the free selectable sendername and sender email address, you need to enter the account name or user name of the email account, the associated password (please don´t mix up with the service password) and the name of the outgoing mail server.



By clicking the OK button, the settings will be accepted and a test email will be sent to the specified recipient address for verification, if selected by the checkbox.

To support encrypted transmission such as SSL (Secure Sockets Layer) or its successor TLS (Transport Layer Security), you can invoke an additional window for configuring the email protocol by clicking the "advanced..." button:



Encrypted transmission is supported from Windows XP or Server 2003 (or higher). Depending on the type of transmission, the following port settings are common:

Port 25 with unencrypted transmission ("Plain Text")
Port 465 with "SSL, TLS or DTLS"
Port 587 with "STARTTLS"

If necessary, please ask your email provider for the required values of the individual parameters. You can verify the correctness of the settings by sending a test email.

4 Installation under Linux

The controller types DC-644e, DC-624e, DC-622e, DC-614e, DC-610e and DC-600e RAID can also be installed and used under all known 64 bit (x86_64) Linux distributions starting from kernel version 5.

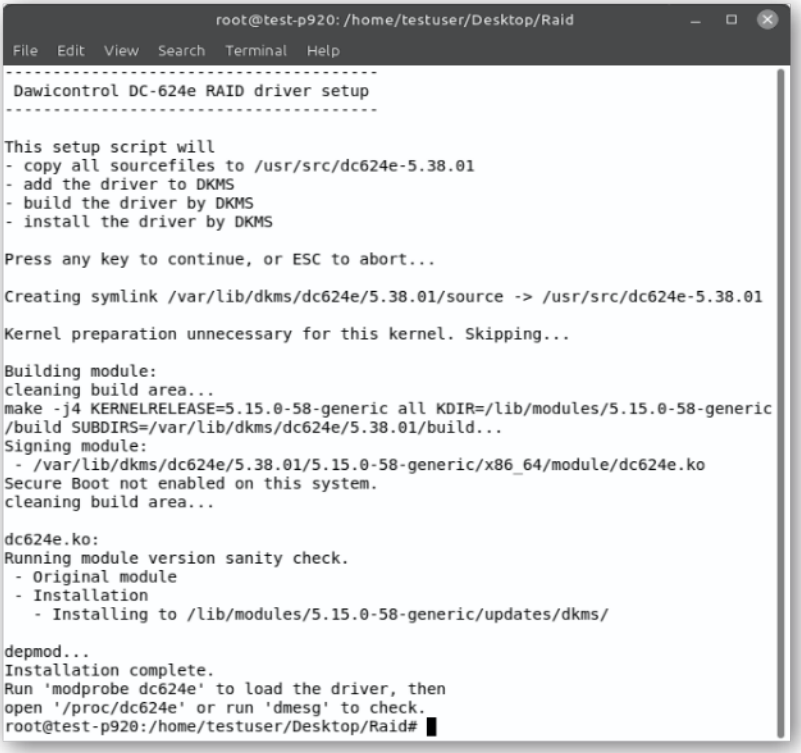
If you intend to use a drive with existing data to create a RAID set under Linux, at least 1 MB must be free at the end of the drive's capacity due to the Linux partitioning scheme, please see chapter 2.4.3.

4.1 Driver building and installation

First make sure, that the BIOS version of the controller is at least 5.36, otherwise the controller might not be recognized by the corresponding driver.

To compile and install the driver, first copy all the files from the Linux directory of the respective controller on the provided CD to any directory on your system, and then open a terminal window from there.

If DKMS (Dynamic Kernel Module Support) is installed on your system, we recommend the installation with the 'setup.sh' installation-script: this ensures a DKMS-compliant installation, and the driver will be automatically updated during kernel updates. Execute the script by entering 'bash setup.sh' and follow the instructions:



In case that DKMS is not installed on your system, then instead enter 'make install' in the terminal window. Please note, that in any case you must have root privileges, i.e. you may need to prefix the commands with 'sudo'.

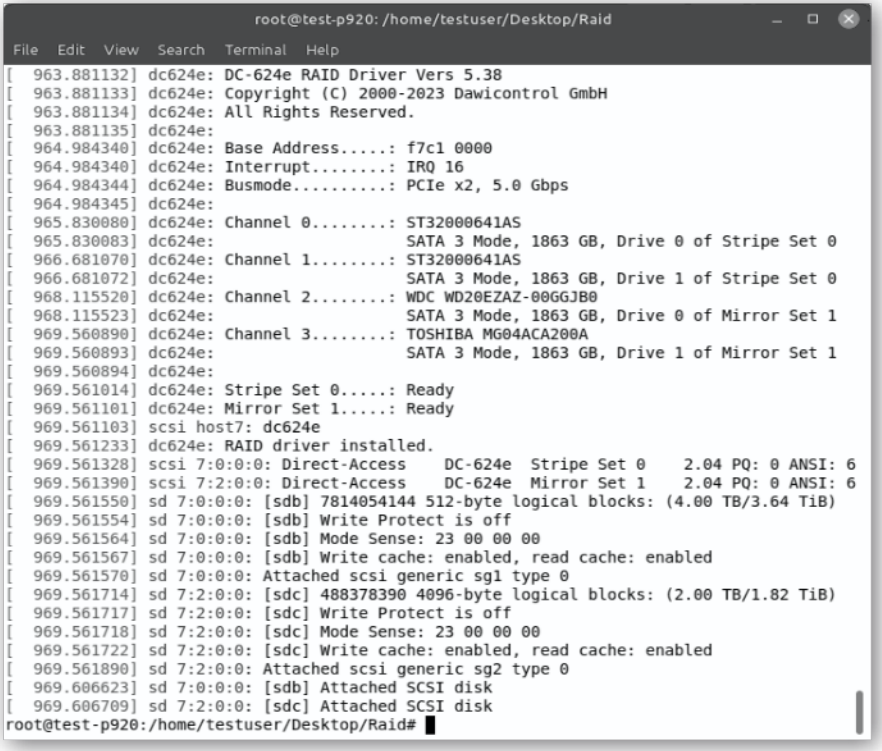
Additionally, it is necessary that the kernel header files matching your system, as well as the C compiler and its associated programs and tools ('build essentials'), are installed.

In both cases, the driver will be created and installed to match your system. Depending on whether you have created the driver with 'bash setup.sh' or 'make install', it will subsequently be located in the directory '/lib/modules/[kernelvers]/updates' or in '/lib/modules/[kernelvers]/extra'.

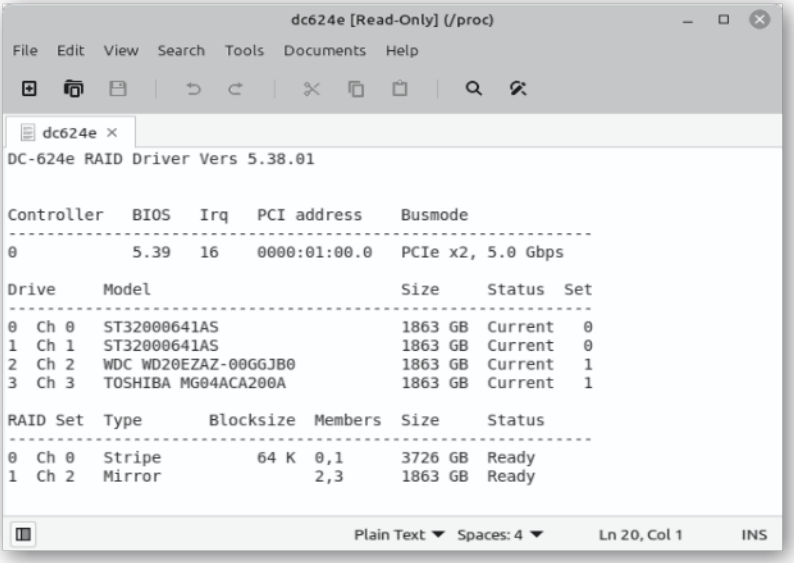
4.2 Driver loading

After successfully compiling and installing the driver, you can load the driver using 'modprobe'. To do this, enter 'modprobe dc624e' (replace 'dc624e' with the name of the respective controller).

The controller streams its installation message as well as any errors or warnings during operation (e.g. in case of a drive failure) to the kernel log file. You can view or print these messages by invoking 'dmesg':



Furthermore, you can check and verify the status of the controller, as well as the attached drives and RAID sets, using the file associated with the controller in the '/proc' directory (e.g., 'dc624e'):



In order for the driver to be loaded automatically at system startup, it can be added to the initial RAM filesystem ('initramfs'). Depending on the Linux distributions and versions, this will be done in different ways. Here are some examples (for safety, you should create a backup of the 'initramfs' before):

- For Debian, Ubuntu, Linux Mint and their derived versions, you need to add a line with the name of the driver (e.g. 'dc624e') to the file '/etc/initramfs-tools/modules', then the 'initramfs' image needs to be rebuilt using 'update-initramfs -u'.

  Furthermore, adding a line with the name of the driver to the file '/etc/modules' (e.g., 'dc624e') also results in automatic loading of the driver, but at a slightly later stage when the root filesystem has already been mounted.
- For Arch Linux and its derivatives, the name of the driver needs to be added to the 'MODULES' section in the file '/etc/mkinitcpio.conf', so that the drivers entry reads like 'MODULES=(dc624e)'. Then execute 'mkinitcpio -P linux' in order to create a new 'initramfs' image.
- For Fedora and openSUSE, an additional entry under 'force_drivers+=' with the drivername is needed in the file '/etc/dracut.conf'. This entry should read like 'force_drivers+=" dc624e "' (please note the spaces and double quotes). Then execute 'mkinitrd' in order to create a new 'initramfs' image.

As with the installation, you must have root privileges for this task as well.

After the initial RAM filesystem has been successfully updated, the driver will be loaded automatically each time the system is restarted.

4.3 Installation during Linux installation

If Linux is to be newly installed on a drive or RAID set connected to the controller, the driver must be added to the initial RAM filesystem ('initramfs') during installation using a so-called 'CHROOT' environment. This requires additional steps that should only be performed by experienced users. The procedure is illustrated here using Ubuntu (and derived Linux versions) as an example:

- start Linux as usual from the installation medium, e.g., a USB stick.
- install and load the driver as previously described.
- install Linux as usual onto the drive or RAID set attached to the controller.
- at the end of the Linux installation, do not restart the system, but create a chroot environment instead to modify the newly installed system. The following steps are required:
- verify that the target drive or RAID set for the Linux installation is mounted under the intended directory '/target'. If this is not the case, the installation partition must be mounted manually.
- open the '/target' directory as a system administrator.
- copy the directory with the previously compiled driver to the directory '/target/lib/modules/[kernelvers]'.
- add the drivername to the file '/target/etc/initramfs-tools/modules' as described in the previous chapter.
- open a terminal window and create a chroot environment with the following commands:

  'mount --bind /proc /target/proc'
  'mount --bind /dev /target/dev'
  'mount --bind /sys /target/sys'

- add the driver to the initial RAM filesystem ('initramfs') of the new system with the following commands:

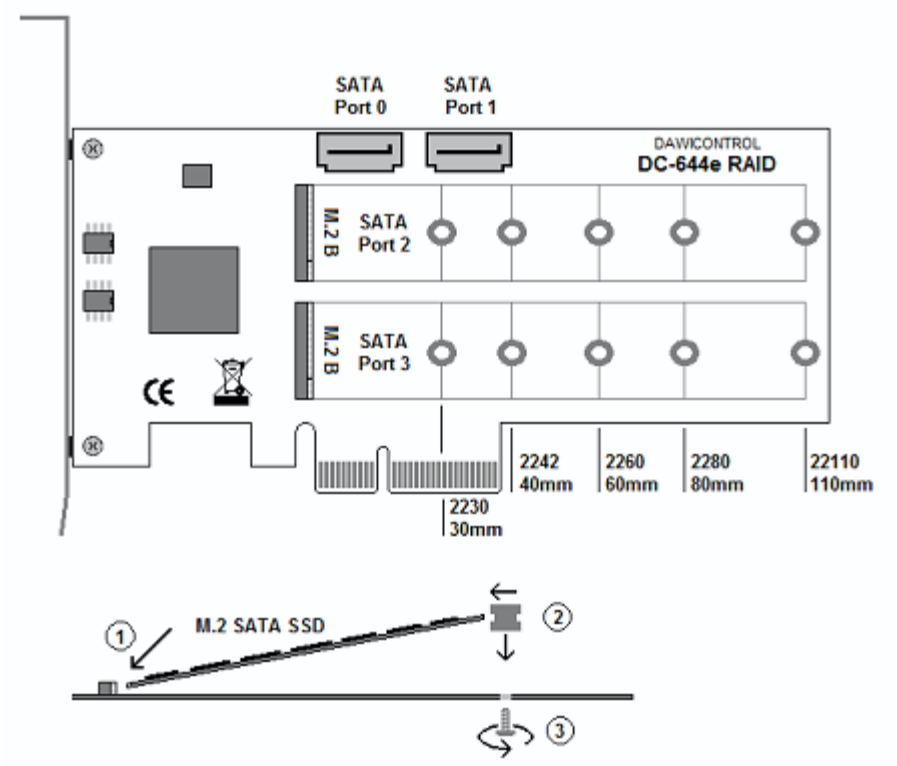
  'chroot /target depmod -a'
  'chroot /target update-initramfs -u'

After that, the driver is installed on the target system, and the newly installed system can be booted directly from the controller.

5 Appendix

5.1 Controller description

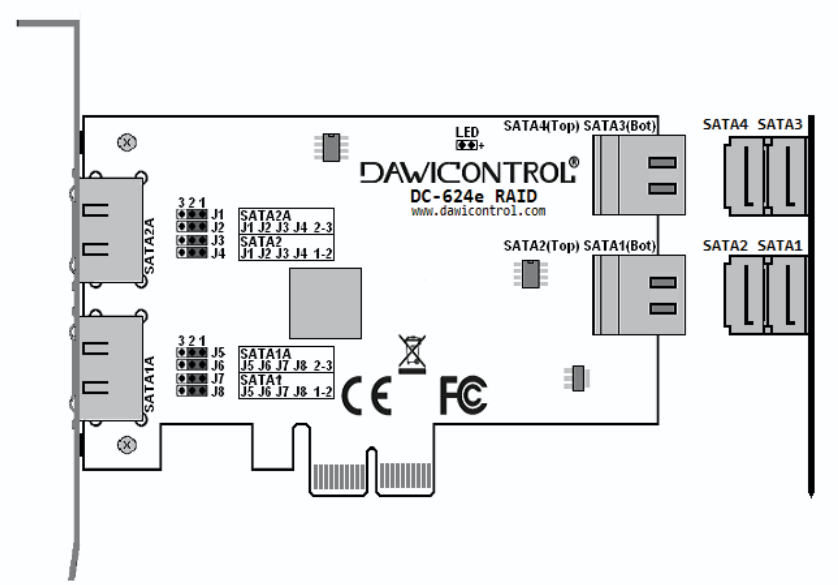
5.1.1 DC-644e RAID



Mounting the M.2 SATA SSDs:

- insert the M.2 SATA SSD into the slot at a slight angle
- place the spacer into the notch and press it down
- screw the spacer into place from the back of the controller

5.1.2 DC-624e RAID



Jumper LED **LED connector**

An LED can be connected here to indicate drive activity. The LED shows the activity of all attached drives.

Jumper J1 – J4 **eSATA2 connector**

Jumper at position 1-2 SATA connector (SATA2) enabled
Jumper at position 2-3 eSATA connector (SATA2A) enabled

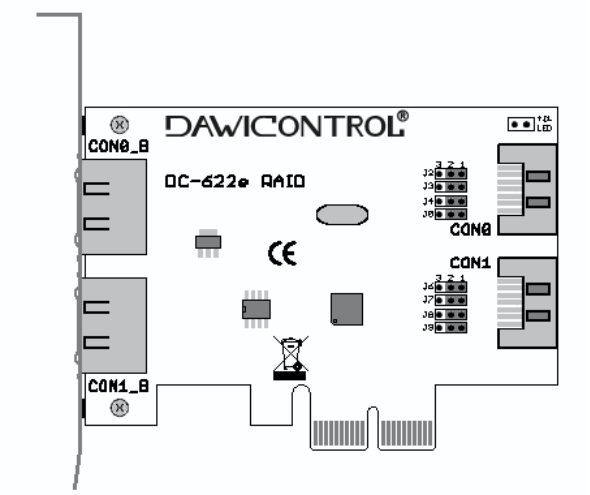
Attention:
For proper function, all four jumpers must always be set to the same position!

Jumper J5 – J8 **eSATA1 connector**

Jumper at position 1-2 SATA connector (SATA1) enabled
Jumper at position 2-3 eSATA connector (SATA1A) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

5.1.3 DC-622e RAID



Jumper J1 **LED connector**

An LED can be connected here to indicate drive activity. The LED shows the activity of all attached drives.

.

Jumper J2 – J5 **eSATA0 connector**

Jumper at position 1-2 SATA connector (CON0) enabled
Jumper at position 2-3 eSATA connector (CON0_B) enabled

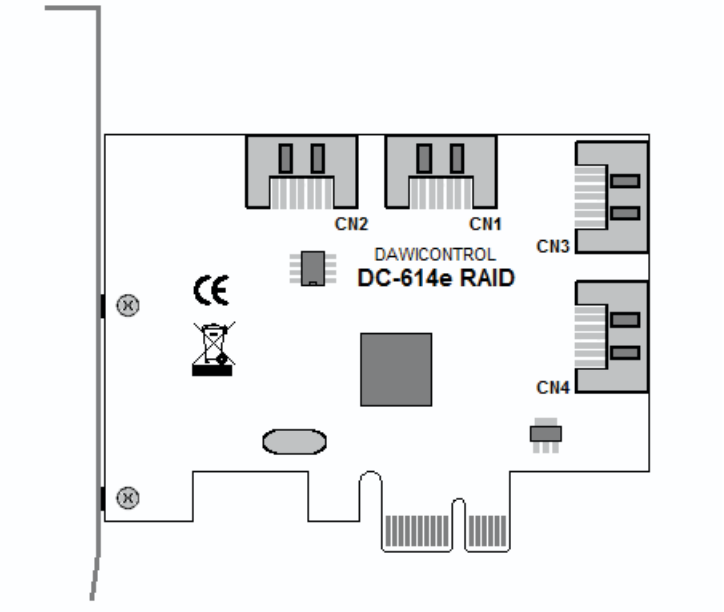
Attention:
For proper function, all four jumpers must always be set to the same position!

Jumper J6 – J9 **eSATA1 connector**

Jumper at position 1-2 SATA connector (CON1) enabled
Jumper at position 2-3 eSATA connector (CON1_B) enabled

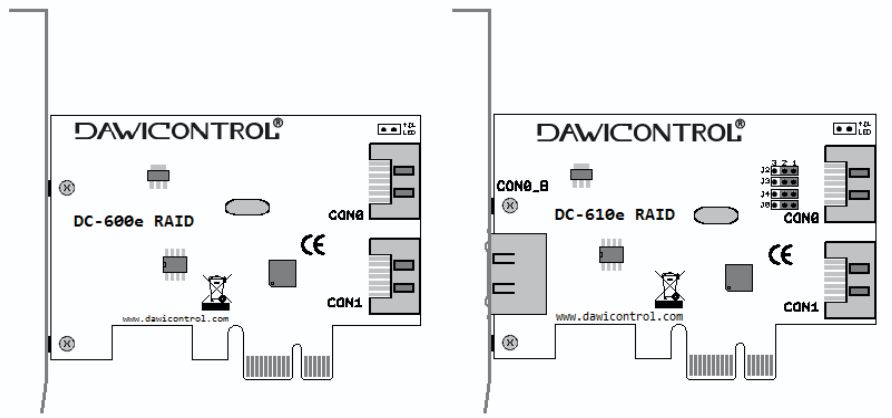
Attention:
For proper function, all four jumpers must always be set to the same position!

5.1.4 DC-614e RAID



Connector	SATA Port
CN1	SATA Port 0
CN2	SATA Port 1
CN3	SATA Port 2
CN4	SATA Port 3

5.1.5 DC-600e RAID / DC-610e RAID



DC-600e RAID **DC-610e RAID**

Jumper J1 **LED connector** An LED can be connected here to indicate drive activity. The LED shows the activity of all attached drives.

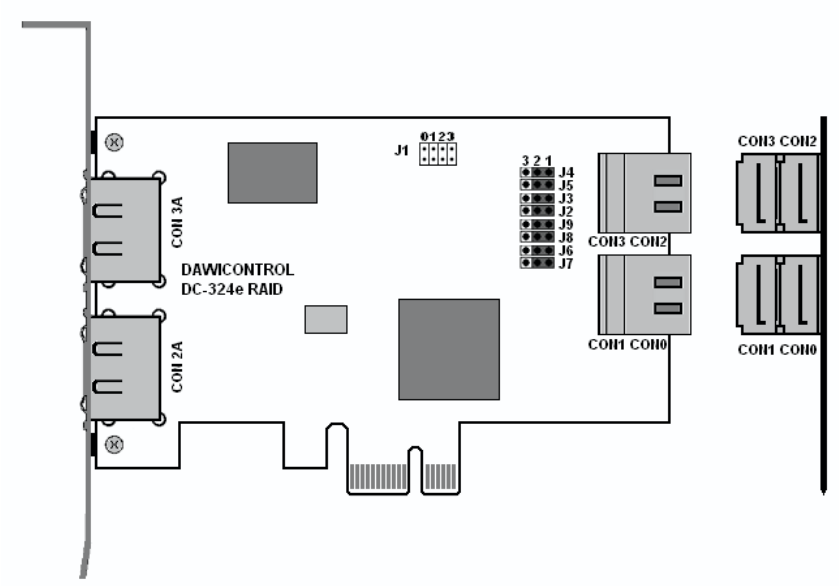
DC-610e RAID eSATA connector

The first SATA port can be assigned either to connector CON0 or CON0_B by the jumpers J5 - J8:

Jumper J5 – J8	eSATA connector
Jumper at position 1-2	SATA connector (CON0) enabled
Jumper at position 2-3	eSATA connector (CON0_B) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

5.1.6 DC-324e RAID



Jumper J1

Joined LED operation: The LED at position 0 indicates the activity of the attached drives of all 4 ports.

Single LED operation: Additional LEDs can be connected to positions 1, 2 and 3 to indicate the activities of drives attached to the ports 1, 2 and 3.

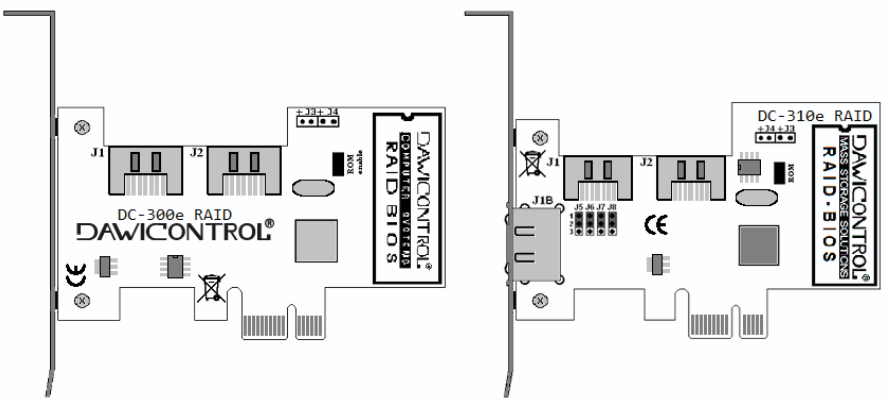
Jumper J6 – J9	**eSATA Port (CON 2A)**
Jumper at position 1-2	SATA connector (CON 2) enabled
Jumper at position 2-3	eSATA connector (CON 2A) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

Jumper J2 – J5	**eSATA Port (CON 3A)**
Jumper at position 1-2	SATA connector (CON 3) enabled
Jumper at position 2-3	eSATA connector (CON 3A) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

5.1.7 DC-300e RAID / DC-310e RAID



DC-300e RAID **DC-310e RAID**

Jumper „ROM“	**Controller BIOS**	The BIOS should only be disabled in case of boot problems, as otherwise the controller can only be operated by a special non-RAID driver. To use the Dawicontrol standard driver, leave the BIOS enabled and simply deactivate it according to Chapter 2.4.7 Controller settings.
Jumper closed	enabled	
Jumper open	disabled	
Jumper J3 J4	**LED connector**	An LED can be connected for each port to indicate drive activities.

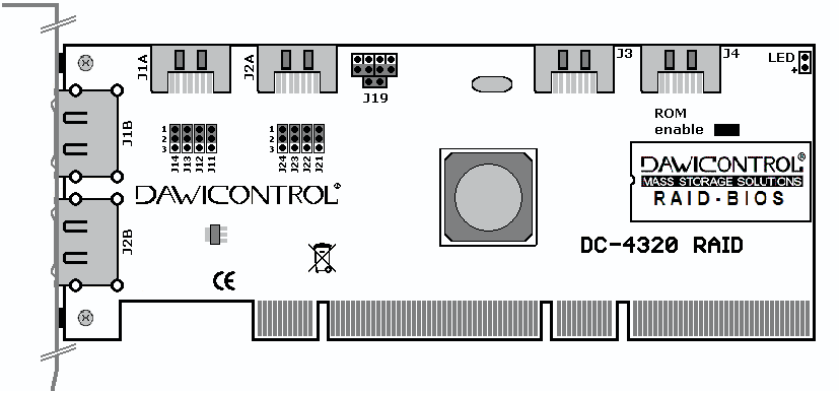
DC-310e RAID eSATA connector

The first SATA port can be assigned either to connector J1 or J1B by the jumpers J5 - J8:

Jumper J5 – J8	**eSATA connector**
Jumper at Position 1-2	SATA connector (J1) enabled
Jumper at Position 2-3	eSATA connector (J1B) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

5.1.8 DC-4320 RAID



Jumper „ROM enable“	**Controller BIOS**
Jumper closed	enabled
Jumper open	disabled

The BIOS should only be disabled in case of boot problems, as otherwise the controller can only be operated by a special non-RAID driver. To use the Dawicontrol standard driver, leave the BIOS enabled and simply deactivate it according to Chapter 2.4.7 Controller settings.

Jumper J19

Single LED operation: If all jumpers are removed from the J19 patch panel, a single LED can be connected to the four adjacent connections for each port. Also the individual jumper across remains open.

Joined LED operation: By this configuration, any single LED indicates the activities of all attached drives (default setting).

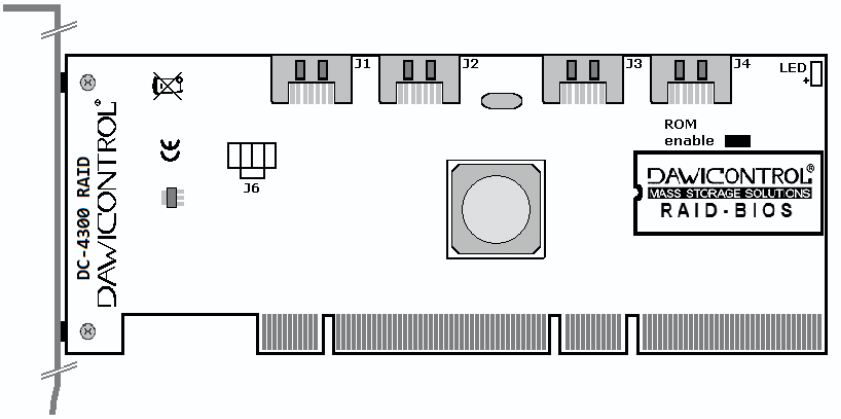
Jumper J11 – J14	**eSATA connector (J1)**
Jumper at position 1-2	SATA connector (J1A) enabled
Jumper at position 2-3	eSATA connector (J1B) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

Jumper J21 – J24	**eSATA connector (J2)**
Jumper at position 1-2	SATA connector (J2A) enabled
Jumper at position 2-3	eSATA connector (J2B) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

5.1.9 DC-4300 RAID



Jumper „ROM enable“	**Controller BIOS**
Jumper closed	enabled
Jumper open	disabled

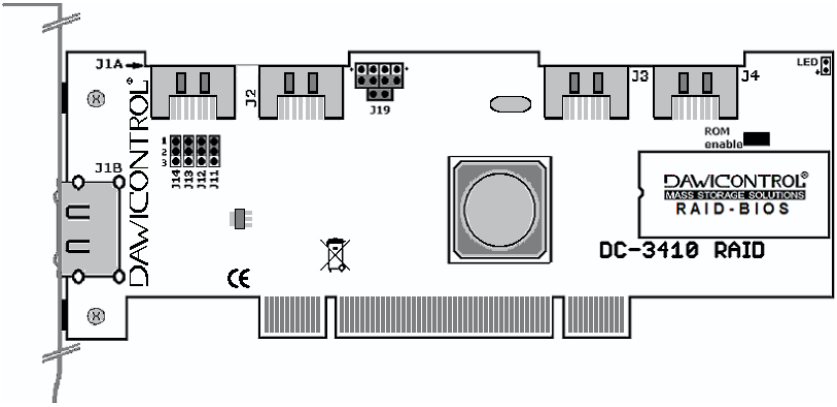
The BIOS should only be disabled in case of boot problems, as otherwise the controller can only be operated by a special non-RAID driver. To use the Dawicontrol standard driver, leave the BIOS enabled and simply deactivate it according to Chapter 2.4.7 Controller settings.

Jumper J6

Single LED operation: If all jumpers are removed from the J6 patch panel, a single LED can be connected to the four adjacent connections for each port. Also the individual jumper across remains open.

Joined LED operation: By this configuration, any single LED indicates the activities of all attached drives (default setting).

5.1.10 DC-3410 RAID



Jumper „ROM enable“	**Controller BIOS**
Jumper closed	enabled
Jumper open	disabled

The BIOS should only be disabled in case of boot problems, as otherwise the controller can only be operated by a special non-RAID driver. To use the Dawicontrol standard driver, leave the BIOS enabled and simply deactivate it according to Chapter 2.4.7 Controller settings.

Jumper „J19“

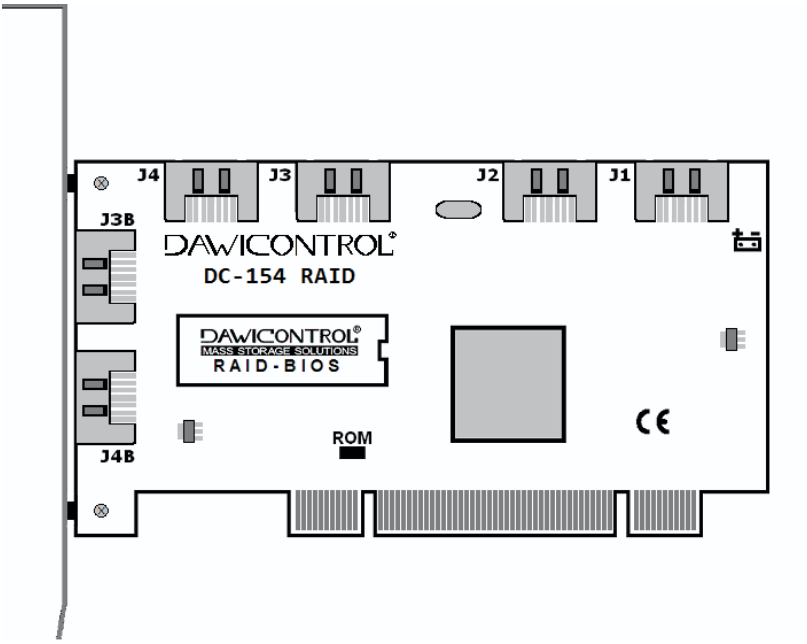
Single LED operation: If all jumpers are removed from the J19 patch panel, a single LED can be connected to the four adjacent connections for each port. Also the individual jumper across remains open.

Joined LED operation: By this configuration, any single LED indicates the activities of all attached drives (default setting).

Jumper J11 – J14	**eSATA connector (J1)**
Jumper at position 1-2	SATA connector (J1A) enabled
Jumper at position 2-3	eSATA connector (J1B) enabled

Attention:
For proper function, all four jumpers must always be set to the same position!

5.1.11 DC-154 RAID

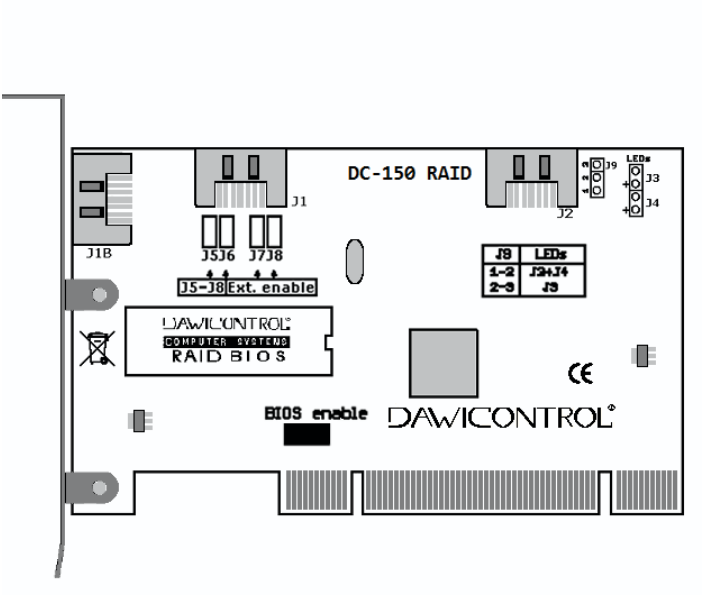


Jumper „ROM“	**Controller BIOS**	The BIOS should only be disabled in case of boot problems, as otherwise the controller can only be operated by a special non-RAID driver. To use the Dawicontrol standard driver, leave the BIOS enabled and simply deactivate it according to Chapter 2.4.7 Controller settings.
Jumper closed	enabled	
Jumper open	disabled	

External SATA connectors J3B and J4B

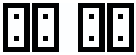
The external connectors J3B and J4B may not be used at the same time as their associated internal connectors J3 and J4, but can only be used alternatively. If, for example, the external connector J3B is in use, then the internal connector J3 must remain unused and vice versa.

5.1.12 DC-150 RAID

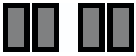


Jumper „BIOS enable“	**Controller BIOS**	
Jumper closed	enabled	The BIOS should only be disabled in case of boot problems, as otherwise the controller can only be operated by a special non-RAID driver. To use the Dawicontrol standard driver, leave the BIOS enabled and simply deactivate it according to Chapter 2.4.7 Controller settings.
Jumper open	disabled	

Jumper J5 – J8



All Jumpers open: the external connector (J1B) is disabled, the internal connector (J1) is enabled.

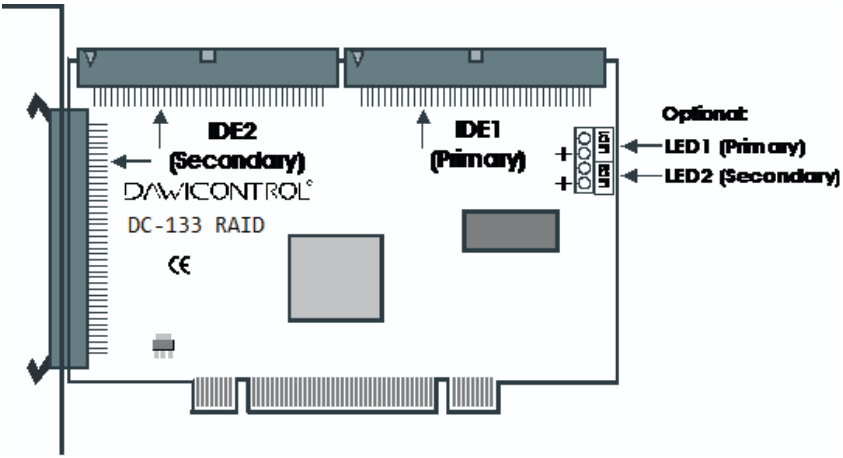


All Jumpers closed: the external connector (J1B) is enabled, the internal connector (J1) is disabled.

Jumper J9

Position 1-2	You can connect individual LEDs to J3 and J4 in order to indicate the activities of the drives separately from each other.
Position 2-3	The activities of all attached drives will be indicated at connector J3.

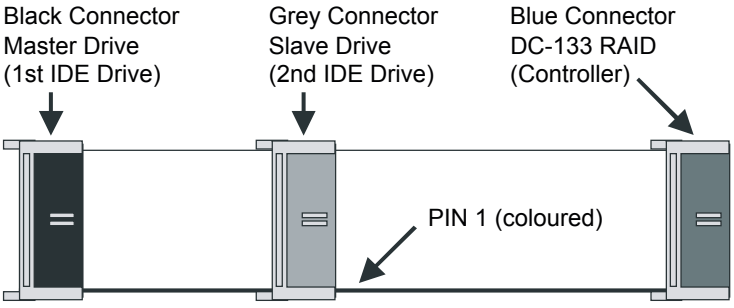
5.1.13 DC-133 RAID



Attachment of UDMA drives

You can attach up to 2 IDE drives to each of the two IDE channels. The secondary IDE port (IDE2) can optionally also be used externally. Because the two secondary IDE ports are connected in parallel, the external and internal IDE ports may not be used at the same time. Under no circumstances should you use 40-pin IDE cables, only 80-pin UDMA133 cables. When using a 40-pin IDE cable, you can only use the UDMA 33 mode.

Before you connect the IDE drives, the jumper settings of the drives must be configured correctly: the first drive at the cable should be set as master, the second drive as slave.



5.2 RAID troubleshooting

In case of any problem with the RAID controller, please check the following points before contacting our hotline or your dealer:

- is the RAID controller installed properly ?
- are the connections between the controller and the drives ok ?
- do the used SATA cables have the appropriate specification ?
- is there a power cable connected to each drive ?
- is the associated driver correctly installed by the device manager ?

If all the above conditions are met and you still cannot resolve the issue, please contact your dealer or call our toll-free hotline. Please have the information about the controller type, drive type, operating system and driver version number ready.

5.2.1 Recovering a damaged RAID set

If a drive of a RAID set has failed, you will receive an error message from the controller BIOS when the system is booted and, if the RAID monitor is configured accordingly, a pop-up window and / or an email notification. The status of the affected RAID set will be "Rebuild" or "Broken". With a RAID 1, RAID 10 or RAID 5 set, the failure of a single drive is tolerated and does not result in any loss of data.

- If the failed drive is still available or is available again, a rebuild process is started automatically and the affected drive is marked with "Rebuild".
- If there is a configured spare drive with sufficient capacity attached to the RAID controller, this will be automatically integrated into the RAID set as "hotspare" drive and a rebuild process will be also started. In this case, the previous failed drive will no longer be used and will be marked as "Dropped".
- If the failed drive is no longer available and there is no spare drive available either, the RAID set will be referred as "Broken" and the failed drive should be replaced as soon as possible.
- This replacement drive can either be added to the RAID set manually by the RAID Setup integrated in the controller BIOS, or (with hotplug-capable controllers) automatically during operation. Its capacity must at least match the smallest of all drives configured in the RAID set.
- For manual installation, invoke the controller BIOS after connecting the drive. From there select "F3 Repair" and the affected RAID set. Now add the new drive to the RAID set using the "Add / Replace Drive" function as described in chapter 2.4.5. The required rebuild process can either be done by the "Rebuild / Complete Set" function at BIOS level, or after a restart in background at operating system level. All data on this drive will be irretrievably erased by this.

  Chapter 2.4.5.1 describes the manual installation of a replacement drive step-by-step and in more detail.

- With the automatic installation of a replacement drive, a drive previously configured as spare drive must be attached to the controller by hotplug at the operating system level during operation. Then this spare drive will be automatically integrated into the damaged RAID set and a rebuild process will be started. If the auto hotspare function is enabled (see chapter 2.4.7), this will be also done with any other unpartitioned drive with sufficient capacity without having to configure it as a spare drive before.

  Warning: in this case all data of this drive will be irretrievably overwritten or erased without any further request.

5.3 Frequently asked questions (FAQs)

Question: Is it also possible to use drives of different SATA generations or ATA hard drives in a RAID set?

Answer: Yes, the RAID controller is downward compatible and older drives can also be operated. For performance reasons however, mixed operation is not recommended.

Question: Should the onboard IDE / SATA controllers be disabled when using an additional RAID controller?

Answer: No, the controller is designed that it can easily be operated in parallel with the onboard controllers. In some cases it may be necessary to switch the operating mode of the onboard controller.

Question: Do the attached drives have to be configured as RAID or can single drives also be operated?

Answer: Both RAID sets and single drives can be operated, even together by one controller.

Question: Can several RAID sets be operated by one controller?

Answer: Yes, several RAID sets can be operated by one controller without any problem.

Question: Can several RAID controllers be operated in one system?

Answer: Yes, it is easily possible to operate several Dawicontrol RAID controllers in one system. If necessary, the "Boot enable" option should be disabled at the controller Setup settings for those controllers, from which booting is not necassary in order to keep the UMB area free for the other controllers, see also chapter 2.4.7.

Question: Can a RAID set be used, that was created on another controller?

Answer: Yes, all Dawicontrol controllers are compatible with each other. Other manufacturers' settings differ and are not compatible. In this case you will have to recreate the array. With a RAID 0, RAID 10 or RAID 5 set, all existing data will be lost!

Question: Is the TRIM command supported?

Answer: Yes, from Windows 8 / Server 2012 onwards, all Dawicontrol RAID controllers will support the TRIM command, both for single drives and for RAID drives.

Question: No drives are recognized or a DMA error is reported?

Answer: In some Intel-based systems, the use of the IOMMU is not correctly implemented. In this case, the "Intel VT-d" setting in the mainboard BIOS should be disabled.

Question: Which settings should be made at the mainboard BIOS, if the RAID controller is to be used for booting?

Answer: If no further drives are installed, it is usually not necessary to change the settings of the mainboard / system BIOS. Otherwise, in older systems without BBS (BIOS Boot Specification) support, the boot sequence must be set to "SCSI".

With more modern systems, generally the boot sequence can be freely selected. In order to do this, invoke the "Advanced" or "Boot" menu of the mainboard BIOS. There the controller and its attached drives should be listed by their name at "Hard Drive BBS Priorities" or at "Boot Option". If there are several drives attached to the system, first their order may have to be specified at "Hard Drive BBS Priorities" and then the selection can be made at "Boot Option".

If the controller supports UEFI (DC-644e, DC-624e, DC-622e, DC-614e, DC-610e and DC-600e RAID) it is still necessary in case of an UEFI system to choose between UEFI and Legacy boot mode. Otherwise the Legacy boot mode must be enabled in the boot settings.

Question: How can the BIOS of a Dawicontrol RAID controller be switched off?

Answer: From the Controller BIOS Setup, invoke the "Controller Settings" menu by pressing the "F10" key. Change the value of the entry "Boot enable" to "No": the controller BIOS will be deactivated, but still available for configuration and maintenance of RAID sets, see also chapter 2.4.7.

Question: During the Windows installation, the error message "Windows can´t be installed on this drive" appears after the driver has been installed (error code 0x80300001)?

Answer: Insert the Windows DVD again and click on the "Refresh" button. The installation can then be continued.

Question: How to access the SMART data of the attached drives?

Answer: There are various programs for drive monitoring, which also are supporting RAID controllers. We recommend the "Hard Disk Sentinel" program, which operates perfectly and reliably with our RAID controllers and recognizes both single drives and RAID drives. You will find Hard Disk Sentinel for download on our website or on the supplied CD: to install it, change to the directory "\ Software \ Hard Disk Sentinel" and invoke the installation program "hdsentinel_pro_setup".

If you decide to purchase the full version of "Hard Disk Sentinel", you will get an exclusive discount of 30% when you enter the coupon code "Dawicontrol".

Notes