# CFast cards

## 1 General information

CFast cards are easily replaceable storage media. Due to their robustness against and environmental influences (temperature, shock, vibration, etc.), CFast cards offer optimal values for use as storage media in industrial environments.

CFast cards are a further development of CompactFlash cards, but the SATA protocol is used here. CFast cards are not compatible with CompactFlash cards.

## 2 Basic information

CFast cards used in industrial automation must be extremely reliable. To achieve this, the following points are very important:

- The flash technology used
- An efficient algorithm to maximize service life
- Good mechanisms for detecting and correcting flash memory errors

### 2.1 Flash technology

CFast cards are currently available with multi-level cell (MLC) and single-level cell (SLC) flash blocks.

SLC flash blocks have a service life 10 times longer than MLC flash blocks and are characterized above all by 33 times the number of write/erase cycles, which makes CFast cards with SLC flash blocks the preferred choice for industrial applications. These factors are strongly dependent on the application, however, so that no general statement is possible.

Due to increasing cost pressure, improved wear level algorithms and improved monitoring features (S.M.A.R.T.), MLC flash technology is increasingly finding its way into this market.

### 2.2 Wear leveling

Wear leveling refers to an algorithm that can be used to maximize the service life of a CFast card. A distinction is made between the following algorithms:

- Dynamic wear leveling
- Static wear leveling

The basic idea of wear leveling is that data is distributed over a wide range of blocks or cells on the data storage medium so that the same areas do not always have to be erased and reprogrammed.

#### 2.2.1 Dynamic wear leveling

Dynamic wear leveling offers the possibility to use unused flash blocks when writing to a file.
If the data storage medium is already 80% full of files, only 20% can be used for wear leveling.
The service life of the CFast card therefore depends on the unused flash blocks.

#### 2.2.2 Static wear leveling

Static wear leveling additionally monitors which data is rarely modified. From time to time, the controller moves this data to blocks that have already been programmed frequently to avoid further wear and tear of the cells.

### 2.3 ECC error correction

Inactivity or operation of a particular cell can cause bit errors. Error-correcting code (ECC) implemented by the hardware or software allows many such errors to be detected and corrected.

## 2.4 S.M.A.R.T. support

Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.) is an industry standard for mass storage devices that has been introduced to monitor key parameters and detect imminent failures at an early stage. Monitoring and storing critical performance and calibration data attempts to predict the probability of error states.

## 2.5 Calculating the expected service life for an existing application

To better verify whether an SLC or MLC CFast card should be used for an existing application, the following procedure is recommended:

- Read the "Average erase count" of the data storage medium via S.M.A.R.T.
- Fully operate the system with the relevant data storage medium over a defined period of time (e.g. 1 week).
- Determine the used erase cycles via "Average erase count".
- Determine the expected service life based on the maximum guaranteed write/erase cycles (MLC: 3000, SLC: 100,000).

  Example of an MLC CFast card in a one-week period:

$$\text{Expected service life} = \frac{3000 * 1 \text{ week}}{\text{Completed erase cycles}}$$

## 2.6 Dimensions

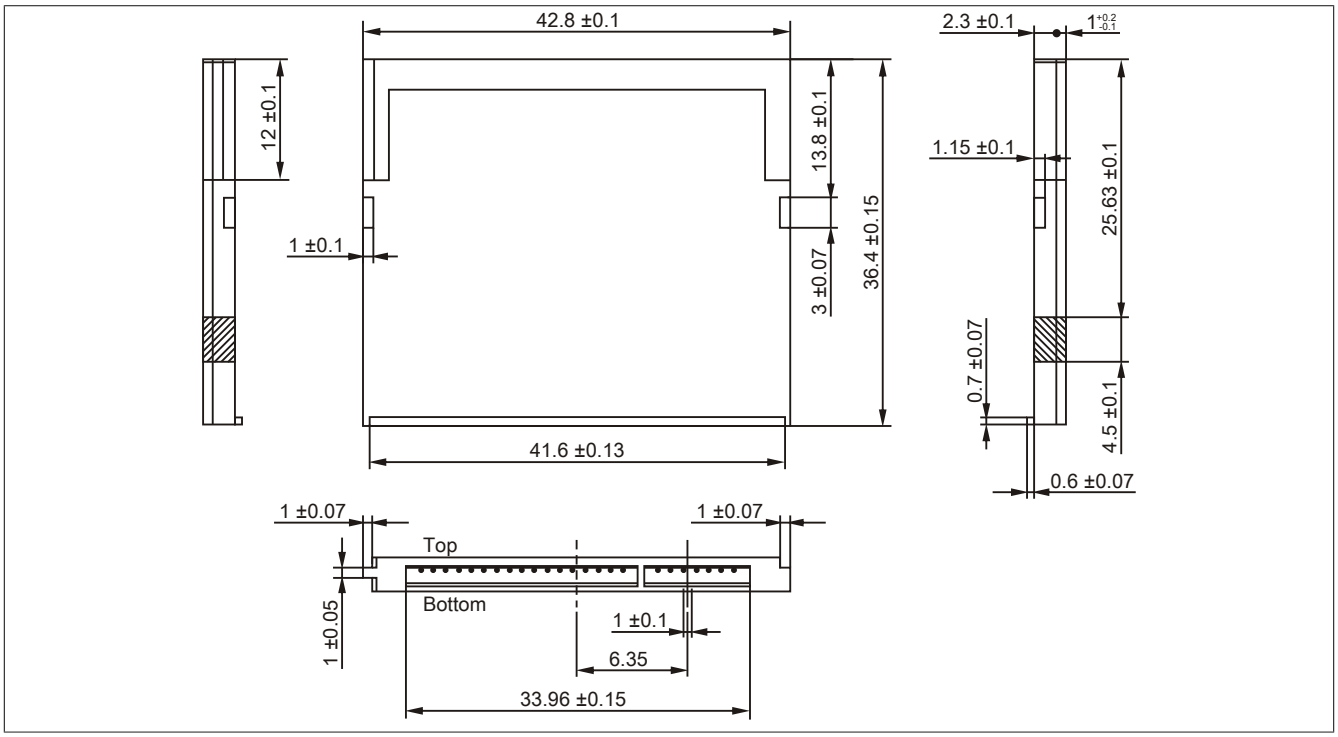


Figure 1: CFast card - Dimensions

# 3 5CFAST.xxxx-00

## 3.1 General information

These CFast cards are based on single-level cell (SLC) technology and compatible with SATA 2.6. The dimensions are identical to CompactFlash cards.

## 3.2 Order data

| Model number | Short description | Figure |
|---|---|---|
| | **CFast cards** |   |
| 5CFAST.2048-00 | CFast 2 GB SLC | |
| 5CFAST.4096-00 | CFast 4 GB SLC | |
| 5CFAST.8192-00 | CFast 8 GB SLC | |
| 5CFAST.016G-00 | CFast 16 GB SLC | |
| 5CFAST.032G-00 | CFast 32 GB SLC | |

Table 1: 5CFAST.2048-00, 5CFAST.4096-00, 5CFAST.8192-00, 5CFAST.016G-00, 5CFAST.032G-00 - Order data

## 3.3 Technical data

### Caution!

**A sudden power failure can lead to data loss! In very rare cases, the mass storage device may also be damaged!**

**In order to prevent data loss or damage, the use of a UPS is recommended.**

### Information:

**Due to the changeover to the new controller, revision E0 may not be image-compatible with previous revisions when using old cloning tools. With current cloning tools, this behavior usually does not occur.**

### Information:

**The following specified characteristic data, features and limit values are only valid for these accessories and may differ from those of the complete system. The data specified for the complete system applies to the complete system in which this accessory is used, for example.**

| Model number | 5CFAST.2048-00 | 5CFAST.4096-00 | 5CFAST.8192-00 | 5CFAST.016G-00 | 5CFAST.032G-00 |
|---|---|---|---|---|---|
| **General information** | | | | | |
| Capacity | 2 GB | 4 GB | 8 GB | 16 GB | 32 GB |
| Data retention [1)] | 10 years | | | | |
| Data reliability | <1 unrecoverable error per $10^{14}$ bits read | | | | |
| Lifetime monitoring | Yes | | | | |
| MTBF | >2,500,000 hours (at 25°C) | | | | |
| Servicing | None | | | | |
| Supported operating modes | SATA 2.6, max. PIO mode 4, Multiword DMA mode 2, Ultra DMA mode 6 | | | | |
| Continuous reading | | | | | |
| Typical | | | | | |
| With 128 kB block size | 94 MB/s | 108 MB/s | | | 116 MB/s |
| With 4 kB block size | 42 MB/s | 46 MB/s | | | |
| Maximum | | | | | |
| With 128 kB block size | 100 MB/s | 115 MB/s | | | 120 MB/s |
| With 4 kB block size | 50 MB/s | | | | |

Table 2: 5CFAST.2048-00, 5CFAST.4096-00, 5CFAST.8192-00, 5CFAST.016G-00, 5CFAST.032G-00 - Technical data

## CFast cards

| Model number | 5CFAST.2048-00 | 5CFAST.4096-00 | 5CFAST.8192-00 | 5CFAST.016G-00 | 5CFAST.032G-00 |
|---|---|---|---|---|---|
| Continuous writing | | | | | |
| Typical | | | | | |
| With 128 kB block size | 57 MB/s | 86 MB/s | | | 111 MB/s |
| With 4 kB block size | 36 MB/s | 40 MB/s | | | |
| Maximum | | | | | |
| With 128 kB block size | 65 MB/s | 95 MB/s | | | 120 MB/s |
| With 4 kB block size | 40 MB/s | 45 MB/s | | | |
| Certifications | | | | | |
| CE | Yes | | | | |
| UL | cULus E115267<br>Industrial control equipment | | | | |
| HazLoc | cULus HazLoc E180196<br>Industrial control equipment<br>for hazardous locations<br>Class I, Division 2, Groups ABCD, T4[2)] | | | | |
| DNV GL | Temperature: **B** (0 - 55°C)<br>Humidity: **B** (up to 100%)<br>Vibration: **A** (0.7 g)<br>EMC: **B** (bridge and open deck)[3)] | | | | |
| **Endurance [1)]** | | | | | |
| SLC flash memory | Yes | | | | |
| Guaranteed data volume | | | | | |
| Guaranteed [4)] | 185 TBW | 371 TBW | 745 TBW | 1468 TBW | 2937 TBW |
| Erase/Write cycles | | | | | |
| Guaranteed | 100,000 | | | | |
| Wear leveling | Static | | | | |
| S.M.A.R.T. support | Yes | | | | |
| **Support** | | | | | |
| Hardware | APC3100, APC2200, APC2100, APC910, PPC3100, PPC2200, PPC2100, PPC900 | | | | |
| Operating systems | | | | | |
| Windows 10 IoT Enterprise LTSB 64-bit | No | | | | Yes |
| Windows Embedded 8.1 Industry Pro 32-bit | No | | | Yes | |
| Windows Embedded 8.1 Industry Pro 64-bit | No | | | | Yes |
| Windows 7 32-bit | No | | | Yes | |
| Windows 7 64-bit | No | | | | Yes |
| Windows Embedded Standard 7 32-bit | No | | | Yes | |
| Windows Embedded Standard 7 64-bit | No | | | Yes | |
| Windows XP Professional | No | Yes | | | |
| Windows Embedded Standard 2009 | Yes | | | | |
| B&R Linux 9 | No | Yes | | | |
| B&R Linux 8 | No | Yes | | | |
| Software | | | | | |
| PVI Transfer | ≥V4.0.0.0.8 (part of the PVI Development installer ≥ V3.0.2.3014) | | | | |
| B&R Embedded OS Installer | ≥V3.10 | | | ≥V3.20 | ≥V3.21 |
| **Ambient conditions** | | | | | |
| Temperature | | | | | |
| Operation | -40 to 85°C | | | | |
| Storage | -50 to 100°C | | | | |
| Transport | -50 to 100°C | | | | |
| Relative humidity | | | | | |
| Operation | Max. 85% at 85°C, non-condensing | | | | |
| Storage | Max. 85% at 85°C, non-condensing | | | | |
| Transport | Max. 85% at 85°C, non-condensing | | | | |
| Vibration | | | | | |
| Operation | 10 to 2000 Hz: 20 g peak | | | | |
| Storage | 10 to 2000 Hz: 20 g peak | | | | |
| Transport | 10 to 2000 Hz: 20 g peak | | | | |
| Shock | | | | | |
| Operation | 1500 g peak, 0.5 ms | | | | |
| Storage | 1500 g peak, 0.5 ms | | | | |
| Transport | 1500 g peak, 0.5 ms | | | | |

Table 2: 5CFAST.2048-00, 5CFAST.4096-00, 5CFAST.8192-00, 5CFAST.016G-00, 5CFAST.032G-00 - Technical data

| Model number | 5CFAST.2048-00 | 5CFAST.4096-00 | 5CFAST.8192-00 | 5CFAST.016G-00 | 5CFAST.032G-00 |
|---|---|---|---|---|---|
| **Mechanical properties** | | | | | |
| Dimensions | | | | | |
| Width | 42.8 ±0.10 mm | | | | |
| Length | 36.4 ±0.10 mm | | | | |
| Depth | 3.6 ±0.10 mm | | | | |
| Weight | 10 g | | | | |

Table 2: 5CFAST.2048-00, 5CFAST.4096-00, 5CFAST.8192-00, 5CFAST.016G-00, 5CFAST.032G-00 - Technical data

1) Per JEDEC (JESD47), EOL conditions are not permitted to be reached before 18 months. A higher average daily write workload reduces the expected service life and data retention of the data storage medium.
2) Yes, but applies only if all components installed in the complete system have this certification and the complete system bears the corresponding mark.
3) Yes, but applies only if all components installed in the complete system have this certification and are listed on the associated DNV GL certificate for the product family.
4) TBW = Terabytes written
Sequential access without file system

## 3.4 Temperature/Humidity diagram

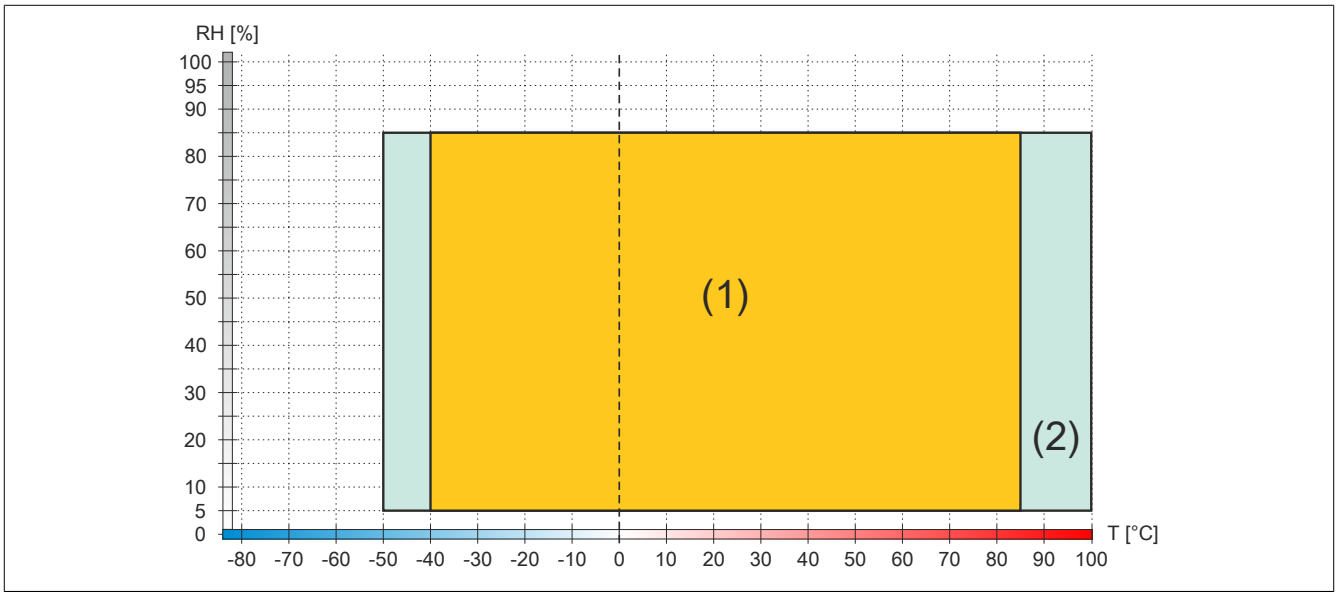


Figure 2: 5CFAST.xxxx-00 - Temperature/Humidity diagram

| Diagram legend | | | |
|---|---|---|---|
| (1) | Operation | T [°C] | Temperature in °C |
| (2) | Storage and transport | RH [%] | Relative humidity (RH) in percent and **non-condensing** |

## 3.5 Dimensions

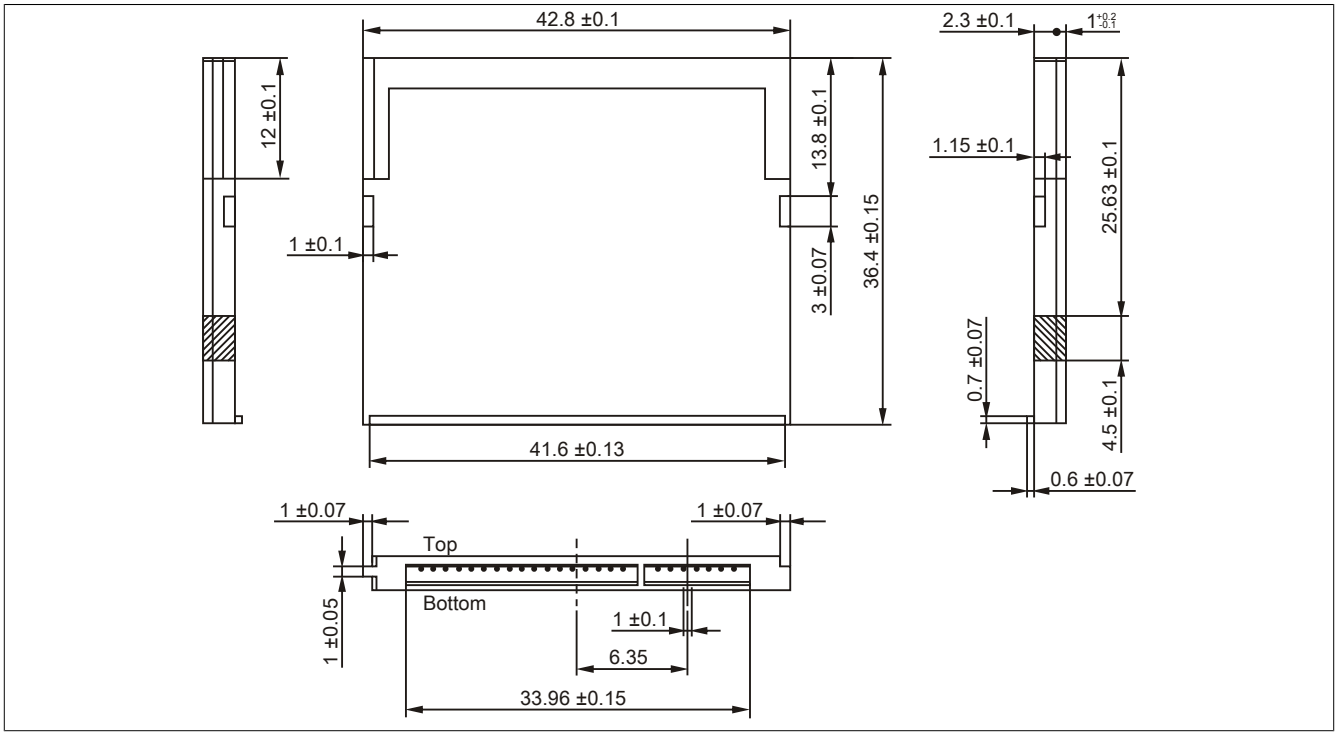


Figure 3: CFast card - Dimensions

# 4 5CFAST.xxxx-10

## 4.1 General information

These CFast cards are based on multi-level cell (MLC) technology and compatible with SATA 3. The dimensions are identical to CompactFlash cards.

## 4.2 Order data

| Model number | Short description | Figure |
|---|---|---|
| | **CFast cards** |   |
| 5CFAST.032G-10 | CFast 32 GB MLC | |
| 5CFAST.064G-10 | CFast 64 GB MLC | |
| 5CFAST.128G-10 | CFast 128 GB MLC | |
| 5CFAST.256G-10 | CFast 256 GB MLC | |

Table 3: 5CFAST.032G-10, 5CFAST.064G-10, 5CFAST.128G-10, 5CFAST.256G-10 - Order data

## 4.3 Technical data

### Caution!

**A sudden power failure can lead to data loss! In very rare cases, the mass storage device may also be damaged!**

**In order to prevent data loss or damage, the use of a UPS is recommended.**

### Information:

**The following specified characteristic data, features and limit values are only valid for these accessories and may differ from those of the complete system. The data specified for the complete system applies to the complete system in which this accessory is used, for example.**

| Model number | 5CFAST.032G-10 | 5CFAST.064G-10 | 5CFAST.128G-10 | 5CFAST.256G-10 |
|---|---|---|---|---|
| **General information** | | | | |
| Capacity | 32 GB | 64 GB | 128 GB | 256 GB |
| Data retention [1] | 10 years [2] | | | |
| Data reliability | <1 unrecoverable error per $10^{16}$ bits read | | | |
| Lifetime monitoring | Yes | | | |
| MTBF | >2,000,000 hours (at 25°C) | | | |
| Servicing | None | | | |
| Supported operating modes | SATA 3, SATA 2, SATA 1 | | | |
| Continuous reading | | | | |
| Maximum | 495 MB/s | 500 MB/s | | |
| Continuous writing | | | | |
| Maximum | 115 MB/s | 100 MB/s | 195 MB/s | 330 MB/s |
| Certifications | | | | |
| CE | Yes | | | |
| UL | cULus E115267<br>Industrial control equipment | | | |
| HazLoc | cULus HazLoc E180196<br>Industrial control equipment<br>for hazardous locations<br>Class I, Division 2, Groups ABCD, T4[3] | | | |
| DNV GL | Temperature: **B** (0 - 55°C)<br>Humidity: **B** (up to 100%)<br>Vibration: **A** (0.7 g)<br>EMC: **B** (bridge and open deck)[4] | | | |
| **Endurance** [1] | | | | |
| MLC flash memory | Yes | | | |

Table 4: 5CFAST.032G-10, 5CFAST.064G-10, 5CFAST.128G-10, 5CFAST.256G-10 - Technical data

| Model number | 5CFAST.032G-10 | 5CFAST.064G-10 | 5CFAST.128G-10 | 5CFAST.256G-10 |
|---|---|---|---|---|
| Guaranteed data volume | | | | |
| Guaranteed [5] | 86.4 TBW | 172.8 TBW | 345.6 TBW | 691.2 TBW |
| Client workload [6] | 39.06 TBW | 71.02 TBW | 104.17 TBW | 159.57 TBW |
| Erase/Write cycles | | | | |
| Guaranteed | 3000 | | | |
| Wear leveling | Static | | | |
| Error-correcting code (ECC) | Yes | | | |
| S.M.A.R.T. support | Yes | | | |
| **Support** | | | | |
| Hardware | APC3100, APC2200, APC2100, APC910, PPC3100, PPC2200, PPC2100, PPC900 | | | |
| Operating systems | | | | |
| Windows 10 IoT Enterprise LTSB 64-bit | Yes | | | |
| Windows Embedded 8.1 Industry Pro 32-bit | Yes | | | |
| Windows Embedded 8.1 Industry Pro 64-bit | Yes | | | |
| Windows 7 32-bit | Yes | | | |
| Windows 7 64-bit | Yes | | | |
| Windows Embedded Standard 7 32-bit | Yes | | | |
| Windows Embedded Standard 7 64-bit | Yes | | | |
| Windows XP Professional | Yes | | | |
| Windows Embedded Standard 2009 | Yes | | | |
| B&R Linux 9 | Yes | | | |
| B&R Linux 8 | Yes | | | |
| Software | | | | |
| PVI Transfer | ≥V4.0.20 or V4.1.5 | | ≥V4.0.22 or V4.1.6 | |
| B&R Embedded OS Installer | ≥V3.21 | | | |
| **Ambient conditions** | | | | |
| Temperature | | | | |
| Operation | -40 to 85°C | | | |
| Storage | -40 to 85°C | | | |
| Transport | -40 to 85°C | | | |
| Relative humidity | | | | |
| Operation | Max. 85% at 85°C, non-condensing | | | |
| Storage | Max. 85% at 85°C, non-condensing | | | |
| Transport | Max. 85% at 85°C, non-condensing | | | |
| Vibration | | | | |
| Operation | 10 to 2000 Hz: 20 g peak | | | |
| Storage | 10 to 2000 Hz: 20 g peak | | | |
| Transport | 10 to 2000 Hz: 20 g peak | | | |
| Shock | | | | |
| Operation | 1500 g peak, 0.5 ms | | | |
| Storage | 1500 g peak, 0.5 ms | | | |
| Transport | 1500 g peak, 0.5 ms | | | |
| **Mechanical properties** | | | | |
| Dimensions | | | | |
| Width | 42.8 ±0.10 mm | | | |
| Length | 36.4 ±0.10 mm | | | |
| Depth | 3.6 ±0.10 mm | | | |
| Weight | 10 g | | | |

Table 4: 5CFAST.032G-10, 5CFAST.064G-10, 5CFAST.128G-10, 5CFAST.256G-10 - Technical data

1) Per JEDEC (JESD47), EOL conditions are not permitted to be reached before 18 months. A higher average daily write workload reduces the expected service life and data retention of the data storage medium.
2) At 25°C ambient temperature at the start of service life.
3) Yes, but applies only if all components installed in the complete system have this certification and the complete system bears the corresponding mark.
4) Yes, but applies only if all components installed in the complete system have this certification and are listed on the associated DNV GL certificate for the product family.
5) TBW = Terabytes written
Sequential access without file system
6) TBW = Terabytes written
Client workload per standard JEDEC JESD219

| Model number | 5CFAST.032G-10 (≤ Rev. F0) | 5CFAST.064G-10 (≤ Rev. D0) | 5CFAST.128G-10 (≤ Rev. D0) |
|---|---|---|---|
| **General information** | | | |
| Capacity | 32 GB | 64 GB | 128 GB |
| Data retention[1)] | 10 years[2)] | | |
| Data reliability | <1 unrecoverable error per $10^{17}$ bits read | | |
| Lifetime monitoring | Yes | | |
| MTBF | >3,000,000 hours (at 25°C) | | |
| Servicing | None | | |
| Supported operating modes | SATA 3, SATA 2, SATA 1 | | |
| Continuous reading | | | |
| Maximum | 300 MB/s | 310 MB/s | |
| Continuous writing | | | |
| Maximum | 75 MB/s | 150 MB/s | |
| Certifications | | | |
| CE | Yes | | |
| UL | cULus E115267<br>Industrial control equipment | | |
| HazLoc | cULus HazLoc E180196<br>Industrial control equipment<br>for hazardous locations<br>Class I, Division 2, Groups ABCD, T4[3)] | | |
| DNV GL | Temperature: **B** (0 - 55°C)<br>Humidity: **B** (up to 100%)<br>Vibration: **A** (0.7 g)<br>EMC: **B** (bridge and open deck)[4)] | | |
| **Endurance[1)]** | | | |
| MLC flash memory | Yes | | |
| Guaranteed data volume | | | |
| Guaranteed[5)] | 86.4 TBW | 172.8 TBW | 345.6 TBW |
| Erase/Write cycles | | | |
| Guaranteed | 3000 | | |
| Wear leveling | Static | | |
| Error-correcting code (ECC) | Yes | | |
| S.M.A.R.T. support | Yes | | |
| **Support** | | | |
| Hardware | APC2100, APC910, PPC2100, PPC900 | | |
| Operating systems | | | |
| Windows 10 IoT Enterprise LTSB 64-bit | Yes | | |
| Windows Embedded 8.1 Industry Pro 32-bit | Yes | | |
| Windows Embedded 8.1 Industry Pro 64-bit | Yes | | |
| Windows 7 32-bit | Yes | | |
| Windows 7 64-bit | Yes | | |
| Windows Embedded Standard 7 32-bit | Yes | | |
| Windows Embedded Standard 7 64-bit | Yes | | |
| Windows XP Professional | Yes | | |
| Windows Embedded Standard 2009 | Yes | | |
| B&R Linux 8 | Yes | | |
| Software | | | |
| PVI Transfer | ≥V4.0.20 or V4.1.5 | | ≥V4.0.22 or V4.1.6 |
| B&R Embedded OS Installer | ≥V3.21 | | |
| **Ambient conditions** | | | |
| Temperature | | | |
| Operation | -40 to 85°C | | |
| Storage | -55 to 95°C | | |
| Transport | -55 to 95°C | | |
| Relative humidity | | | |
| Operation | 10 to 95%, non-condensing | | |
| Storage | 10 to 95%, non-condensing | | |
| Transport | 10 to 95%, non-condensing | | |
| Vibration | | | |
| Operation | 7 to 2000 Hz: 20 g peak | | |
| Storage | 7 to 2000 Hz: 20 g peak | | |
| Transport | 7 to 2000 Hz: 20 g peak | | |
| Shock | | | |
| Operation | 1500 g peak, 0.5 ms | | |
| Storage | 1500 g peak, 0.5 ms | | |
| Transport | 1500 g peak, 0.5 ms | | |

Table 5: 5CFAST.032G-10, 5CFAST.064G-10, 5CFAST.128G-10 - Technical data

| Model number | 5CFAST.032G-10 (≤ Rev. F0) | 5CFAST.064G-10 (≤ Rev. D0) | 5CFAST.128G-10 (≤ Rev. D0) |
|---|---|---|---|
| **Mechanical properties** | | | |
| Dimensions | | | |
| Width | | 42.8 ±0.10 mm | |
| Length | | 36.4 ±0.10 mm | |
| Depth | | 3.6 ±0.10 mm | |
| Weight | | 10 g | |

Table 5: 5CFAST.032G-10, 5CFAST.064G-10, 5CFAST.128G-10 - Technical data

1) Per JEDEC (JESD47), EOL conditions are not permitted to be reached before 18 months. A higher average daily write workload reduces the expected service life and data retention of the data storage medium.
2) At 25°C ambient temperature at the start of service life.
3) Yes, but applies only if all components installed in the complete system have this certification and the complete system bears the corresponding mark.
4) Yes, but applies only if all components installed in the complete system have this certification and are listed on the associated DNV GL certificate for the product family.
5) TBW = Terabytes written
Sequential access without file system

## 4.4 Temperature/Humidity diagram

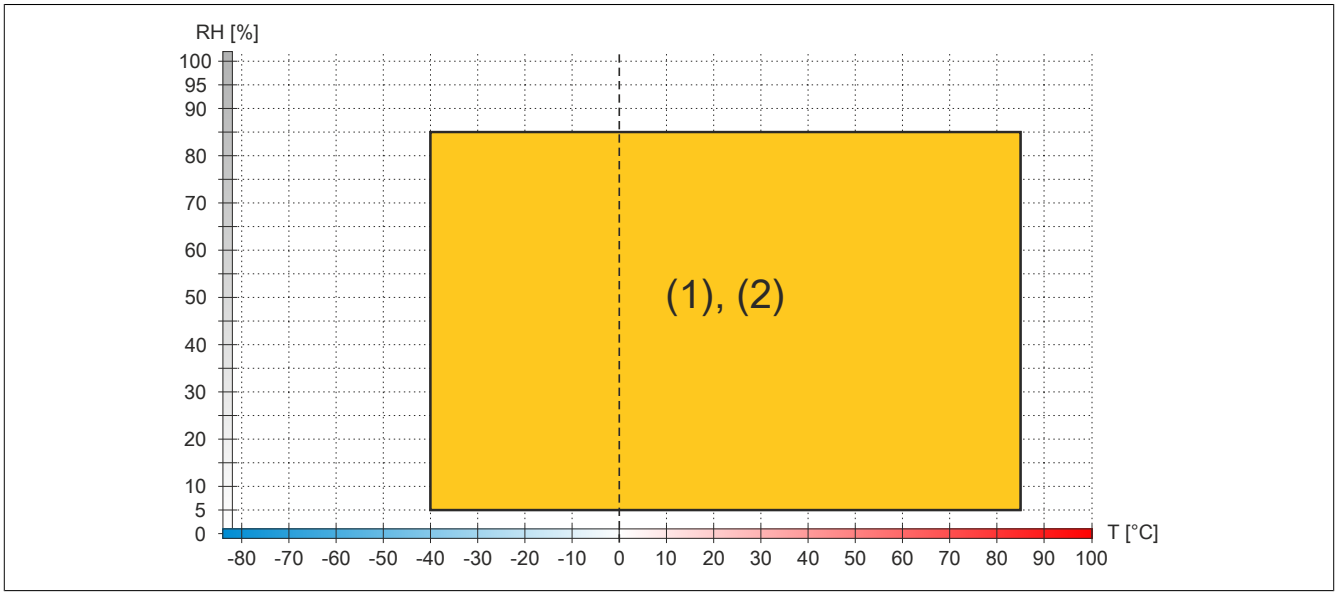


Figure 4: 5CFAST.032G-10 ≥ Rev. G0, 5CFAST.064G-10 ≥ Rev. E0, 5CFAST.128G-10 ≥ Rev. E0, 5CFAST.256G-10 - Temperature/Humidity diagram

| Diagram legend | | | |
|---|---|---|---|
| (1) | Operation | T [°C] | Temperature in °C |
| (2) | Storage and transport | RH [%] | Relative humidity (RH) in percent and **non-condensing** |

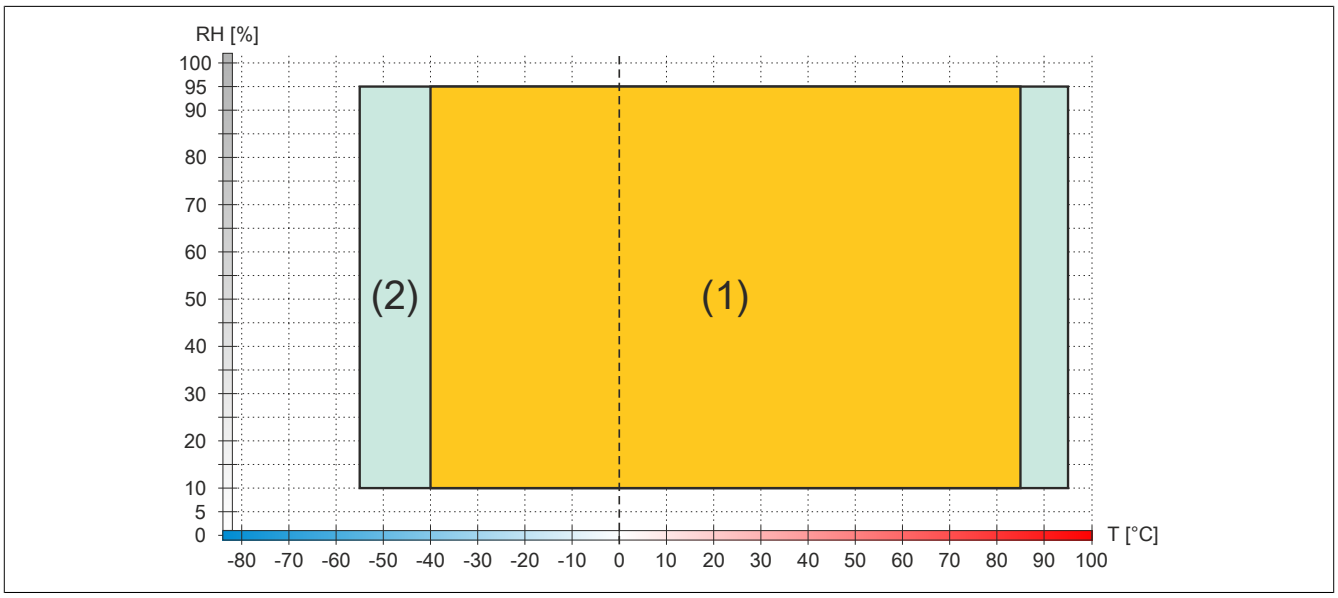


Figure 5: 5CFAST.032G-10 ≤ Rev. F0, 5CFAST.064G-10 ≤ Rev. D0, 5CFAST.128G-10 ≤ Rev. D0 - Temperature/Humidity diagram

| Diagram legend | | | |
|---|---|---|---|
| (1) | Operation | T [°C] | Temperature in °C |
| (2) | Storage and transport | RH [%] | Relative humidity (RH) in percent and **non-condensing** |

### 4.5 Write protection

Write protection can prevent the deletion or modification of data on the CFast card. If write protection is enabled, data can only be read.

## Information:

**If an operating system is installed on the CFast card, write protection must be disabled.**

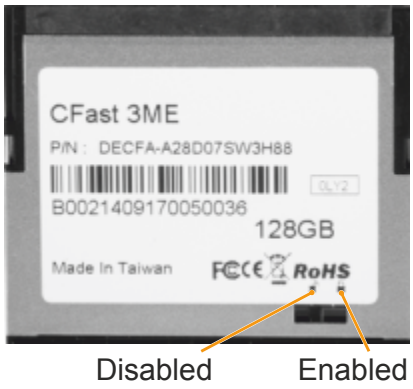


Figure 6: CFast cards - Write protection

Write protection is only available for the following CFast cards:

- 5CFAST.032G-10 ≤ Rev. F0
- 5CFAST.064G-10 ≤ Rev. D0
- 5CFAST.128G-10 ≤ Rev. D0