White Paper
FUJITSU Cool-safe® Advanced Thermal Design

The innovative FUJITSU Cool-safe® Advanced Thermal Design (ATD) is an extension of the Cool-safe® concept which has been successful over many years. Selected servers can thus be operated within greater temperature ranges. This White Paper describes the scenarios involved, the customer benefits and the configuration of the new technology.
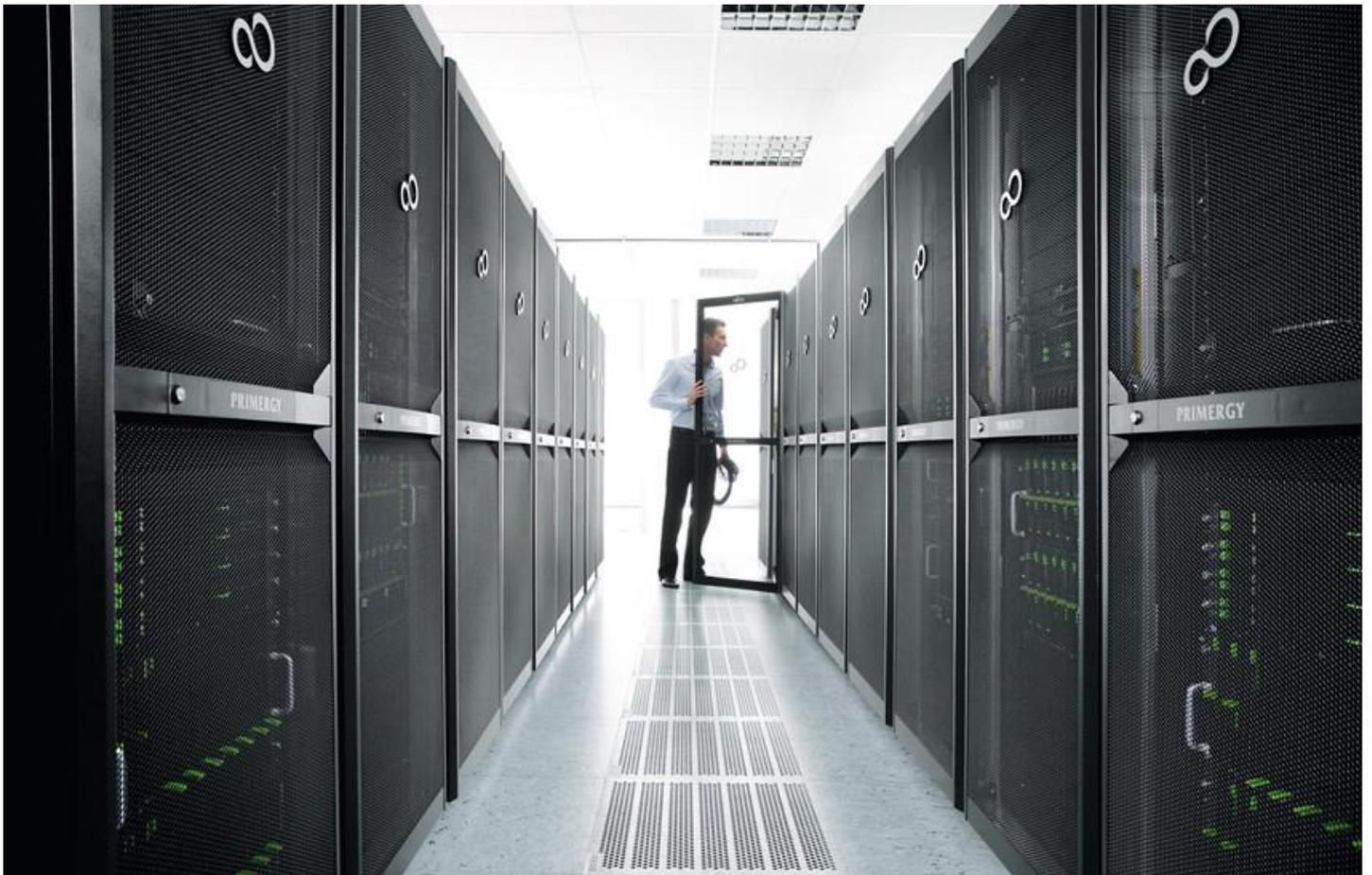
Content

Energy costs can no longer be neglected by companies

In these times of economic change and more and more servers, storage systems and IT infrastructure components being deployed to cope with the emerging amounts of data, companies need optimum efficiency in order to remain competitive in the market. IT must thus meet such demands and provide the tools which not only improve the flow of information and communication but also make company processes and procedures more transparent and efficient. The power consumption costs for a data center use up an enormous share of a company's overall IT budget. Market researchers from the Gartner Group estimate that this share will even increase to as much as 50 % in the long-term. This topic will thus become increasingly important from an economic viewpoint.

Even though IT components are becoming more and more efficient and are reducing power consumption levels for individual systems, the savings are eaten up again by the continually growing demand for storage and computing capacities. And on top of that, the price of industrial electricity itself has more than doubled in the last 12-15 years.

Fujitsu is thus making every effort to develop solutions which will enable customers to improve the individual effectiveness of the energy resources deployed in a data center (known as "power usage effectiveness" PUE). The PUE value defines how efficiently a data center is using its power resources. Power usage effectiveness is calculated based on the quotient for all data center energy against the energy consumption of IT devices.

FUJITSU Cool-safe® Advanced Thermal Design

The Cool-safe® Design, developed by Fujitsu, is an important module which ensures PRIMERGY servers operate as energy-efficient as possible. It is a holistic construction and design concept. The focus is on an optimum balance between the material involved and the performance, efficiency and reliability levels of the PRIMERGY servers. Further information can be found in the White Paper: FUJITSU Cool-safe® Design

Cool-safe® Advanced Thermal Design is an extension of the Cool-safe® concept which has been successfully applied in 2004. A broad range of selected servers can thus be operated within greater temperature ranges. As can be seen in the diagram, the normal temperature range for server operations is between 10 ℃ and 35 ℃. Cool-safe® Advanced Thermal Design extends the range to between 5 ℃ and 40 ℃.

As of the model generation M2, Fujitsu again raised the bar and extended the Cool-safe® Advanced Thermal Design. Some of our tower and rack systems are now also available for an even further increased temperature range of up to 45 ℃, offering more headroom for chiller-less data center or server room set-ups.

The advantages of higher ranges are obvious:
- Servers can be put in hotter rooms without having to cool the rooms specifically.
- Significant savings can thus be obtained regarding energy and cooling costs. According to Gartner an increase in temperature in a room of 5 ℃ means a 20 % saving potential for power consumption for the cooling system. New cooling models for data centers, such as those with fresh air cooling, benefit from the FUJITSU Cool-Safe® Advanced Thermal Design.
- Thanks to a dual step approach to select either 40 ℃ or 45 ℃, the benefits can be chosen just as required
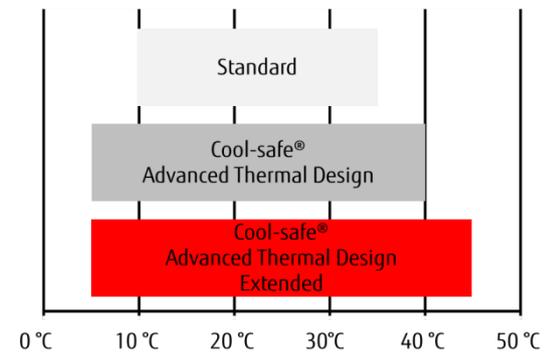

Figure 1: Operating Temperature and the different scales

To be able to offer customers a uniform data center concept and follow a holistic approach it is not just Fujitsu servers that support the Cool-safe® Advanced Thermal Design technology, but also selected FUJITSU Storage ETERNUS systems and network components are available for a higher ambient operating temperature. Fujitsu thus offers its customer a complete infrastructure consisting of servers, storage, and network that supports an ambient temperature of up to 40 ℃ and 45℃, respectively.

It is not only Fujitsu that sees this important trend regarding servers in higher temperature environments. Branch analysts value "high temperature servers" as an important innovation with great potential regarding energy savings. When purchasing a new data center infrastructure, analysts recommend that their customers ensure that the set-up can be used in conjunction with higher temperatures.

Usage scenarios

The implementation options for the FUJITSU Cool-safe® Advanced Thermal Design are wide-ranging.

Free air cooling - for a data center without cooling compressors

In contrast to 100 % air-conditioning with cooling compressors, "free air cooling" partially or completely cools the data center by using the outside temperature. The systems are cooled using either water or fresh air. Water-based cooling generates the required cold air via heat exchangers; the warm water is then cooled outdoors. In contrast, fresh-air systems feed the filtered outside air into the data center. Both types of systems reduce the burden on classic compressor air-conditioning and thus significantly reduce the electricity bill. Fresh-air cooling depends on the target temperature required for the data center and whether outdoor temperatures are low enough.

The "American Society of Heating, Refrigerating and Air-Conditioning Engineers" (ASHRAE) provide temperature range recommendations for energy-efficient data centers. The diagram shows the recommended ASHRAE classes A1-A4 ("recommended envelope") where the relative humidity (exponential curve) must also be taken into consideration. Since 2011, ASHRAE has included two new temperature classes into their analyses, the A3 and A4, which make the free air cooling concept even more interesting.

FUJITSU's Cool-Safe® Advanced Thermal Design covers ASHRAE Class A3, i.e. a temperature range between 5 and 40 °C. This temperature range means that free air cooling can be implemented throughout the year in 99 % of Europe, 97 % of North America and 91 % of Japan. FUJITSU Server PRIMERGY systems thus provide the perfect foundation for a completely fresh-air cooled and thus energy-efficient data center.
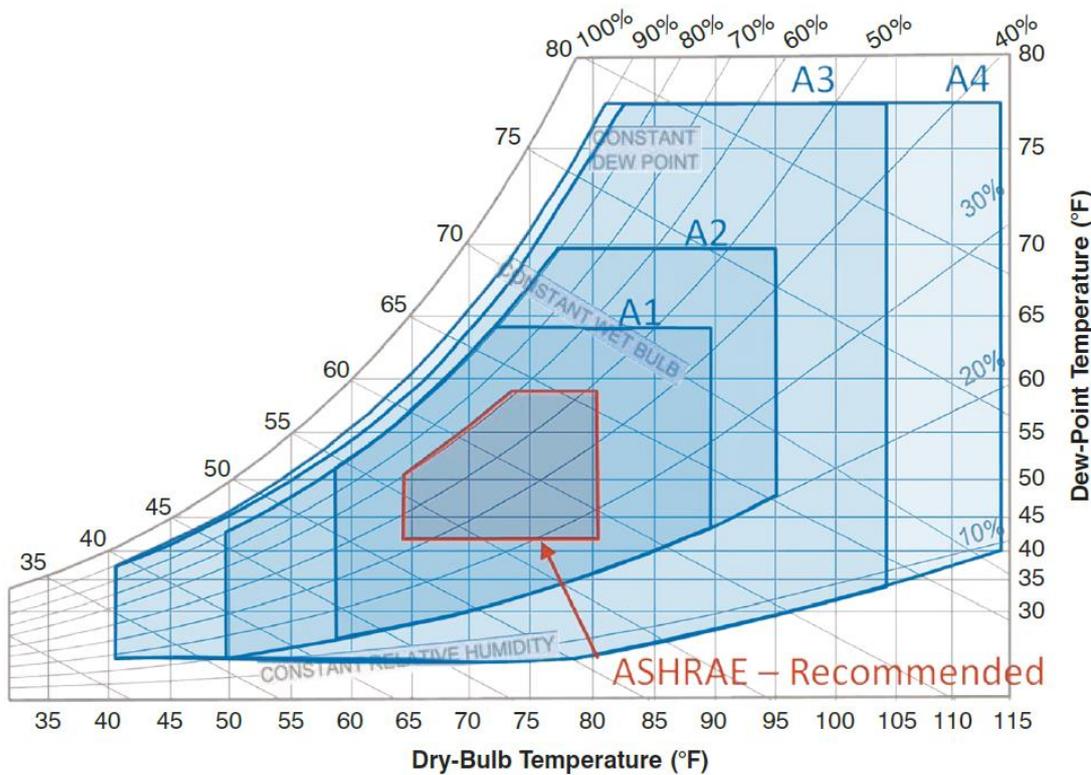

Figure 2: ASHRAE Environmental Classes for Data Centers, source: "The Impact of ASHRAE 2011 Allowable Ranges", The Green Grid

Create warm zones in the data center and lessen the air-conditioning strain.

Converting data centers in one step to handle higher temperatures is only possible in a very low number of data centers. The existing infrastructure is usually too heterogeneous regarding temperature requirements. Nevertheless, creating areas with different temperatures helps to reduce the air-conditioning strain. If the infrastructure is separated via aisles or corridors, then conventional hardware can be supplied with cooler air as usual, and the new 45 °C compatible systems can be supplied with warmer air. The better these aisles are separated by suitable partitioning, the easier it is to define a separate climate for each path. The data center can thus be gradually set up to cope with higher temperatures.

Perfect for the container data center

Data center containers are ideal for bridging the weeks or months when the data center is being converted or extended. However, robust containers can also be used as a backup or central data center. As these container data centers are directly subject to environmental influences, the implemented hardware must be able to cope with a wide range of temperatures as the free air-cooling systems are being used to obtain higher energy-efficiency levels. The systems equipped with FUJITSU Cool-safe® Advanced Thermal Design can be used in temperatures of up to

40 °C in summer and as low as 5 °C in winter. With raising the temperature scale up to 45 °C, some interesting system set-ups can be realized in regions where outside air temperatures are usually not favorable to build IT-infrastructures in containers.

SMEs: Operation in small cupboard-like server rooms

Small and medium-sized companies can also benefit from higher temperatures and FUJITSU's Cool-safe® Advanced Thermal Design. Data centers with their own cooling and ventilation infrastructure, as large companies can afford, cannot be used by small companies or by many medium-sized companies. They usually operate their IT infrastructure in office rooms that have been converted into "data centers". A half-opened window is often the "air-conditioning system". This "free-air cooling" procedure often works in winter without any problems but temperatures can increase in summer to dangerous levels, especially if hot zones are generated due to poor air circulation or insufficient room cleaning or missing filters. Servers are generally designed for operation in temperatures of up to 35 °C. PRIMERGY servers equipped with FUJITSU Cool-safe® Advanced Thermal Design technology operate reliably in temperatures of up to 40 °C, some selected models even up to 45 °C and can thus handle hot summer days in rooms that are not air-conditioned. Hot zones are thus not so worrying.

Regions with warmer climates

Using servers with Cool-safe® Advanced Thermal Design technology in non-climatized server rooms, as described above, is not only possible in moderate climate zones. Implementation is also sensible in subtropical climate zones, such as in the Mediterranean area or North Africa. This is where PRIMERGY servers have competitive advantages as the systems can run without any time restrictions at temperatures between 35 °C and 40 °C. This means maximum flexibility regarding the server location and no worries about long hot periods. For more flexibility, FUJITSU Cool-safe® Advanced Thermal Design can be configured with up to 45 °C to cover extreme situation.

Customer benefits

Higher temperatures, lower costs

The key message for administrators for a long time has been "keep the temperatures in data centers as low as possible". The desired temperature was often about 21 °C. It is only a couple of years ago that there has been a change in the trend. An increasing number of server and storage systems, switches and other data center infrastructure items are being approved for operation in high temperatures. The reason for this is especially obvious in the data center: Higher environmental temperatures mean lower cooling requirements.

Cooling costs in classic data centers cooled with compressors can easily use up between 40 and 60 % of the energy costs. The savings potential is enormous. The branch analyst Gartner calculates a maximum drop of 4 % in cooling costs for each Celsius degree of higher operating temperature. An increase in data center temperature from 21 to 26 °C would mean approx. 20 % fewer air-conditioning costs. FUJITSU Server PRIMERGY systems with Cool-safe® Advanced Thermal Design are designed for operation at temperatures of up to 40 °C and even 45 °C for selected systems. The temperature in the data center can hence be increased by several degrees and still retain an adequate safety buffer.

Incidentally: FUJITSU experts can evaluate the savings and optimization potential for your data center as part of OPTIMIZATION Services and then recommend customized solutions. See below.

Higher temperature buffers for more safety

Cool-safe® Advanced Thermal Design can also help reduce the fear of a failing air-conditioning and ventilation system or simply give you that extra edge of planned A/C downtime during maintenance periods. The failure of such systems can result in increased temperatures in a data center, especially in small or medium-sized companies where the ventilation systems are not designed for redundant use. Whereas conventional hardware is quickly endangered by hot zones, PRIMERGY servers with Cool-safe® Advanced Thermal Design offer more scope for temperature increases, thus providing more safety.

Prepared for the future

It is obvious that future sustainability must be ensured when selecting a new server or infrastructure for the data center. The Gartner analysts suggest that the wrong choice of server platform for the data center will mean work is not possible at high temperatures which in turn lead to unnecessary cooling costs. The "Green Grid" association expects extended temperature ranges in data centers to establish themselves in the coming years. According to Steve Strutt from "The Green Grid" the natural hardware fluctuation and renewal cycles in due time will see data center infrastructures being replaced with new class A3 equipment (see ASHRAE classes in Figure 3).FUJITSU Server PRIMERGY enable you to be prepared for the future - regardless of whether the data center or the small computer room is to be immediately operated within the higher temperature range or whether such deployment still has to be checked.

Made in Germany: High quality at a permanent 40 °C and 45°C

Dedicated simulations, heat emission camera and air throughput measurements on a model were carried out when developing the housing in order to determine suitable cooling procedures for the system components. The system is then subject to comprehensive climate tests during the final development and release phase. So-called climate chamber tests at various temperature ranges (5 to 45 °C, with 10 to 85 % relative humidity) are run for weeks and the effects on the server system are measured by up to 60 temperature sensors.

Effects on reliability

Fujitsu ensures maximum availability of PRIMERGY servers equipped with Cool-safe® Advanced Thermal Design even in extreme temperatures of up to 45 ℃. Everything is based on best availability and reliability - from the mainboards developed and manufactured in Germany through to component selection. Using the proven Fujitsu developed Cool-safe® Technology ensures that the servers are adequately ventilated and cooled.

According to ASHRAE, the operational time limits that apply outside the recommended temperature range (the "envelope" in figure 3) will no longer affect the reliability and operation of IT hardware. FUJITSU Cool-safe® Advanced Thermal Design guarantees unlimited operation at temperatures at 5 ° - 40 ℃ and even up to 45℃ for selected models.

Configuring Cool-safe® Advanced Thermal Design

FUJITSU Cool-safe® Advanced Thermal Design can be optionally configured with a range of PRIMERGY systems.
The following systems are currently supported:

- PRIMERGY RX1330 M2
- PRIMERGY RX2520 M1
- PRIMERGY RX2530 M2
- PRIMERGY RX2540 M2
- PRIMERGY RX2560 M2
- PRIMERGY RX4770 M2
- PRIMERGY TX1320 M2
- PRIMERGY TX1330 M2
- PRIMERGY TX2560 M2
- PRIMERGY CX400 M1

Please note that Cool-safe® Advanced Thermal Design cannot be activated subsequently. All restrictions can be found in the respective system configurator.

Configuration tools and further information

In order to simplify the configuration of PRIMERGY systems with Cool-safe® Advanced Thermal Design, the tool landscape has been extended accordingly.

Fujitsu SystemArchitect

FUJITSU SystemArchitect is used to configure individual PRIMERGY servers and complete racks, plan cabling and calculate power consumption values. SystemArchitect now allows the optional configuration of Cool-safe® Advanced Thermal Design for the supported systems. If the option is selected, any non-supported components are disabled for the configuration so as to prevent incompatibilities.
Please note that Cool-safe® Advanced Thermal Design cannot be activated subsequently.

FUJITSU system configurator and order information guide

All of the configuration options, restrictions and information are described in the configuration instructions within the SystemArchitect. When configuring Cool-safe® Advanced Thermal Design, this information is useful in order to view all non-supported components at a glance.

The restrictions can differ per system. In SystemArchitect, the restricted components are greyed out when the option Cool-safe® Advanced Thermal Design is selected.

Restrictions Overview*:

System/Model	40 ℃ 5 ℃ Cool-safe ATD	Restriction	45 ℃ 5 ℃ Cool-safe ATD	Restriction
PRIMERGY Rack Servers				
PRIMERGY RX1330 M2	yes	Restrictions for CPUs apply No FBU No TPM modules	no	./.
PRIMERGY RX2510 M2	yes	none	yes	none
PRIMERGY RX2520 M1	yes	No Tape Drives	no	./.
PRIMERGY RX2530 M2	yes	none	yes	Not with RAID controller incl. Flash Backup Unit
PRIMERGY RX2540 M2	yes	Not for 12x 3,5" base unit Restrictions for CPUs apply No Grid Cards No Tape Drives	yes	Not for 8x 3,5" and 12x 3,5" base unit Restrictions for CPUs apply No Grid Cards No Tape Drives
PRIMERGY RX2560 M2	yes	none	yes	No Tape Drives
PRIMERGY RX4770 M2	yes	Restrictions for CPU speed apply No PCIe SSD drives supported	no	./.
PRIMERGY Tower Servers				
PRIMERGY TX1320 M2	yes	No Tape Drives	no	./.
PRIMERGY TX1330 M2	yes	No Tape Drives	no	./.
PRIMERGY TX2560 M2	yes	none	yes	No Tape Drives
PRIMERGY Scale-Out Servers				
PRIMERGY CX400 M1	yes	Restrictions for CPUs apply Restrictions for HDDs apply Resrtictions for PCIe options apply No Grid Cards	no	

*The table gives a general hint on what is possible. Please check the individual restrictions within SystemArchitect.

FUJITSU Power Calculator
The power calculator, which is part of SystemArchitect, has been extended to include Cool-safe® ATD functions. In addition to the previous temperature range of 10 to 35 ℃, the extended temperature range of 5 to 40 ℃ is also available as an option. The effect of a higher or lower temperature on the power consumption of fans and other components can thus be calculated as early as the configuration.

Please note that the sizing of the power supply units and cabling in SystemArchitect is always based on temperature of 10 to 25 ℃.