

## Clock Tower with PULS Power

### Power Supplies for the Mecca Tower

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When night falls in Mecca the green dials of the world's largest clock tower are still clearly visible at a distance of min. 10 miles. This is achieved with two million LEDs – and around 1000 power supplies.



The Royal Clock Tower in Mecca stands at a unique location in the immediate vicinity of the most sacred site in all of Islam, the Kaaba. Its exterior dimensions are colossal, at 601 meters in height and 120 stories it is the third tallest building in the world – with a tower clock mounted at a height of above 400 m.

The clocks located at all four sides of the building are also exceptional; externally they appear similar to those of Big Ben in London, but six times as large. The edge length of the clock dial is 43 m and the accessible minute hand measures 22m. The time display should be clearly legible at a long distance. During the daytime the clock dials are white, at night they

are bright green. The hands are black during the day and brilliant white at night.

The tower has been designed and tested to provide a service life of 100 years during which it will have to withstand extreme weather conditions and hurricane-force wind.

PULS has been entrusted with providing the power supplies. Approximately 1000 units of the Dimension XT series, 48V / 20A units deliver the one million Watts required to illuminate the LEDs. As a result the power supplies form the core of the electronic lighting system; if they fail the clock faces remain dark.

The use of so many units in a very restricted space with the requirement of comparatively low heat development could be achieved thanks to the high efficiency of up to 95.5% and the compact size of the power supplies.

Limited space for building automation is often the rule rather than the exception. Power supplies are often located in false floors or in the ceiling space – usually with very restricted height. Intensive development work has seen power supplies reduce in size significantly over recent years. For example 960W units with a 3-phase input have shrunk from an overall width of 275mm in 1993 to an overall width of only 96mm for present day units.

The efficiency of the unit is the key to a compact unit size and low heat. For this reason standard circuit concepts were repeatedly rejected and replaced with innovative, low loss concepts and the later constructive arrangement was considered as a criterion during the selection of the circuit concepts.

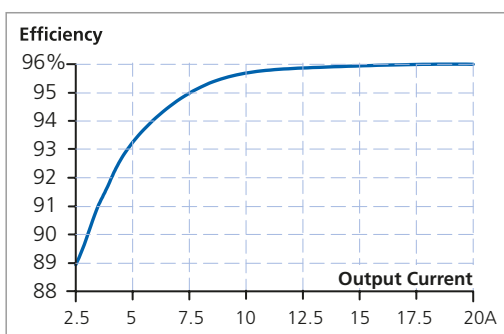
Particularly sensitive components in a switching power supply are the electrolytic capacitors (electrolytic). Depending on their design they dry out over time and regularly wear out. Operating temperature of the component plays an important role in this process; every 10 kelvin of temperature increase halves the service life of an electrolytic capacitor and thus the power supply. For this reason PULS only use electrolytic capacitor designs with a high initial lifetime and take care to achieve the lowest possible component temperature (see graph 1).

But what happens when 1000 power supplies are simultaneously switched on? With commonly available power supplies very high inrush currents would occur. The Mecca project therefore placed particular demands on the inrush current. The solution was an electronic inrush current limiter so that the inrush current would not overload the lines, the power supply and the fuses (see graph 2).

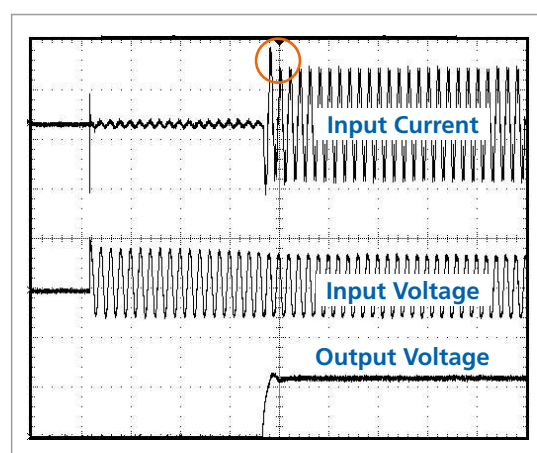


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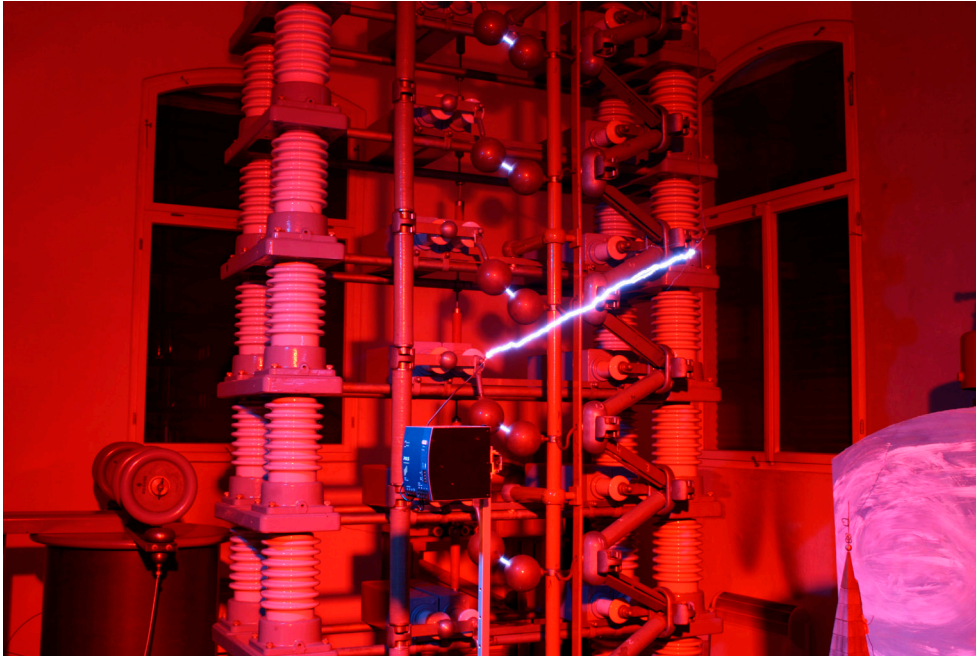
This is often achieved by the use of NTCs (resistor with a negative temperature coefficient). However, these components pose a design problem as they heat up to +170°C and act as a „hot spot“ radiating heat to adjacent components the entire time the system is in operation. For this reason, in the DIMENSION series they are replaced with an electronic circuit that generates very little heat.



Graph 1: Highest efficiencies over entire load range



Graph 2: Power supplies turn on behaviour with virtually no inrush current.



*Harsh Operational Test: A power supply subjected to high voltage conditions.*

A lightning strike to the top of the tower poses a real threat to the Mecca Tower control. This means that the power supplies must have high immunity to ensure uninterrupted service even in the event of a lightning strike. Tests carried out using high voltage strikes on a power supply of 500kV / 4000A did not impair the function of the power supply. During the tests the circuits were exposed to both air discharge and multiple discharges to the power supply input. The robustness of the Dimension Series successfully protected the units from damage.

The tower has shone every night since it was first illuminated at the grand unveiling in late 2012, reliably showing millions of pilgrims „Mecca Time“, which was also planned to be integrated in the calculation of global time.