Many industrial processes use large amounts of heat generated by electricity. This can be expensive, and even more so, if significant quantities of peak power are consumed. ABB’s new DCT880 is a thyristor power controller for heating applications whose integrated power optimization algorithms reduce costs by reducing peak power demands.

General setup
Many industrial heating applications consist of numerous heating elements at the same site. These heating devices may have different energy consumptions when switched on. Some may operate in a coupled manner and they all could be controlled by one supervisory PLC or independently, by local PID controllers. Regardless which setup is actually used, a good power quality is desired. This can be achieved using full-wave burst firing, i.e. by either letting full sine waves pass or by completely blocking them. This is done by switching the device fully on or off. During power optimization, the DCT880 uses full-wave burst firing. Besides this mode, the DCT880 also offers other control methods like halfwave control, soft starts and soft downs as well as phase-angle control.

How is optimization done?
The diagram demonstrates the dramatic difference power optimization can make.

It never exceeds 50 % of the installed capacity. How can this be achieved?
The principle is illustrated below:

Eight heat consumers are shown. They have 100 kW and 200 kW operating powers and utilize between 30 ... 70 % over a 1 s cycle time. The right side shows that the accumulated power consumption is uneven, with a peak after 300 ms.

The above graph shows the same situation, but with a mathematically optimal solution. The periods in which the consumers are switched on are perfectly distributed across the whole cycle. No peak exists in the overall demand.
This perfect distribution can even be achieved in otherwise problematic mid-load situations. Let’s assume, all devices are working at 60 percent utilization. Then there would be a peak in the total power consumption somewhere during the cycle, no matter how the power-on cycles are distributed. This can be easily solved by splitting some of the on-cycles. I.e. switching a consumer twice on and off during one optimization cycle.

**Redundant master feature**

The new DCT880 redundant master feature allows for an easy to configure automatic switchover of the master role to any follower, in case the power optimizer master is offline. This feature can also be used to maintain the power optimization routine without re-configuring the system, even if only some of the optimized DCT880s are in operation.

The redundant master feature works as follows:

1. Node number 1 starts as master. Then the master is not available anymore because it is switched off.
2. The former master unit loses its master function. Then the unit with the lowest node number among the remaining active units takes over the master role. The takeover time is fast enough, so that the production or process is not affected in most applications.
3. Once the connection is re-established, the unit with status ‘Searching’ resumes working as a follower.

**Hardware setup**

Each DCT880 has to be equipped with a memory unit containing the power optimizer (+S552). The devices are coupled via the built-in device-to-device (D2D) communication. Another significant advantage of the solution is its architecture. The optimization is performed completely separated from the rest of the setup. That means, all units keep their individual set points and report them to the master unit. They receive optimized commands in return. Hence, the optimization can be integrated into any setting. It does not matter if there is a supervisory control programmable logic controller (PLC) or if each DCT880 is controlled locally by a separate controller. Further, the production process is not affected by the optimization routine so there is no need to adapt operational planning.

**Customer Benefits**

- Reduced peak power demand.
- Reduced energy cost.
- Reduced installation cost.
- Easy to add option by memory unit (+S552).
- No additional hardware.
- Possibility for active load management by load shedding with prioritization (using the node number).
- Independent D2D link for communication.
- Easy to use, no hard-to-understand tuning parameters.
- Diagnostics signals of all followers in the master unit.
- With redundant master feature: Higher availability of the plant and more flexibility in switching off some of the optimized DCT880s.