Application of MEAN WELL System Power Solution:
Ultra-High Wattage Power Supply System for Synchrotron Light Source Facility

Proven Case Study

In 2020, MEAN WELL's system power solution successfully won one government tender contract for Taiwan Photon Source (TPS) Synchrotron, as DC power supply system for the RF amplifier system within the synchrotron. This power system provides ultra-high energy for electrons to be accelerated to near light speed. Figure 1 shows a common ring structure of a synchronous (electron) accelerator. The inner side is booster ring, and the outer side is storage ring from which multiple experimental stations branch out.

Fig. 1 The ring structure of the synchrotron

Synchrotron Applications

The ultra-high brightness and wide bandwidth spectrum of light source (far-infrared to hard X-ray) generated by the synchrotron can be widely used for experiments in the fields of physics, chemistry, materials, chemical engineering, biology, medicine, geology, archaeology, environmental protection, energy, electronics, microelectromechanical systems (MEMS), nanoscale devices, and etc. It is an indispensable tool for leading-edge fundamental scientific research, biomedical technology and industrial applications in the 21st century. It has contributed to the study of lithium materials achieving long-lasting battery which is essential to the global electric vehicle market nowadays. Additionally, it further helps the deep understanding at research of nanotechnology for which is key element of semiconductor materials and biomedical relevant products development.

Figure 2 shows the illustration of the synchrotron of TPS for which it mainly consists of Linear Accelerator (LINAC), Booster Ring and Storage Ring. The source produces the particles which are propelled up to speed in a LINAC before they are injected into a booster ring to be accelerated further. The particle beams then enter the storage ring, which maintains their speed. In case particle beams are diverted at speeds close to the speed of light, it emits part of the energy as synchrotron radiation in the form of electromagnetic waves. Depending on requirements, the super bright beams are then diverted into the beamline to perform the experiment or application in the end station. RF amplifier system is to compensate the power loss of the particle beams in the storage ring due to the emission of synchrotron radiation by which a signal picked up on ring can be amplified and fed back in on the opposite side of the ring at a dedicated phase angle. The feedback loop helps to reduce the size and energy distribution. MEAN WELL system power solution is installed and applied as the DC power source for the RF amplifier system in the storage ring.

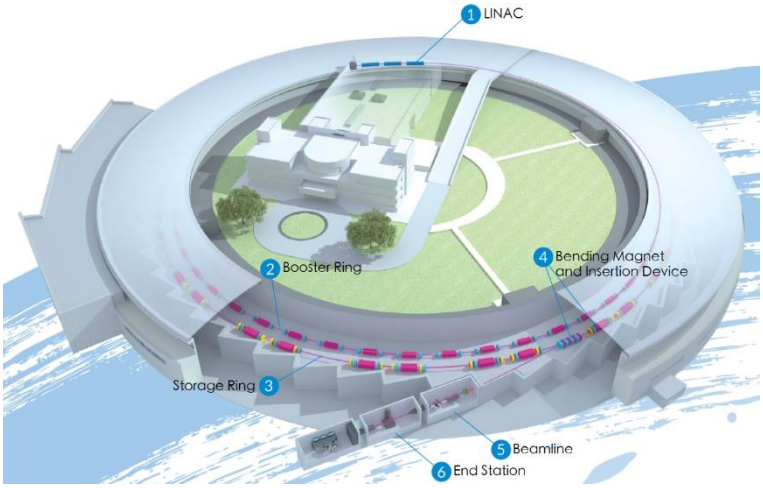

Fig 2. Synchrotron of Taiwan Photon Source

The plan of project is to use multiple sets of 96kW high-power power supply system shown in Figure 3. The output from the power system is for driving solid-state RF power amplifier clusters shown in Figure 4 which generates high-frequency energy for boosting electrons to travel at nearly light speed shown in Figure 5. The maximum output DC power of whole system is up to 800kW!

Fig 3. 96kW High Output Power System

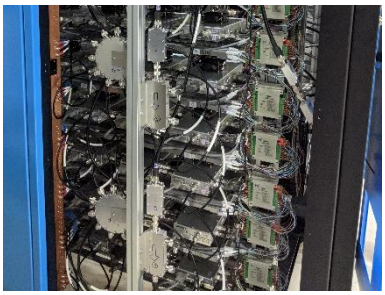

Fig 4. RF Amplifiers Clusters

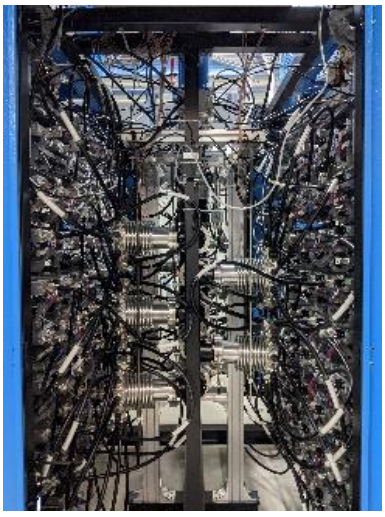

Fig 5. 10-Way Co-axial Power Combiners

To match RF power required by the storage ring and best power efficiency, the output voltage of the power system must be adjustable between 42Vdc to 54Vdc modulation range for each operating point with specific RF power level to achieve best result. The DRP-3200 series equipped with CANbus, digital communication protocol, can achieve the requirement on precise voltage trimming.

Furthermore, the bus voltage of each set of power system needs to be adjusted

synchronously during experiments provided they are not connected in parallel. To achieve it, the external controllers are implemented for remote control. Another challenge is that the accuracy of output power is limited to +/- 1% after trimming. To accomplish it, power supply with fully digital design and communication protocol makes it possible for control and monitoring the system remotely through Ethernet!

Another important factor that DRP-3200-48 being selected is because of its extremely high efficiency which is in line with international trends for energy saving and environmental protection. An increased 0.5% on efficiency of every single power supply in an 800kW system, it will bring substantial economic result and benefit in the case of long-term operation.

Ingredients of MEAN WELL System Power Solution:

MEAN WELL uses the up-to-date technology to build system power solution including: DRP-3200 series as power module with fully digital design, DHP-1UT-A 1U as power shelf, CMU2 as power controller and 19-inch standard rack cabinet. The total output power is up to 128kW.

Benefits of System Power Solution:

1. Integrated solution: it supports digital communication provided key parameters of the power system can be controlled and monitored through the controller remotely to simply power management work.
2. Easy maintenance: it supports hot swap function for which the module can be quickly installed and replaced.
3. Power scalability: it scales from 12.8kW to 128kW high power solutions suitable for different industries and applications where the configuration on parameters required.

Reference

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