DEVELOPMENT OF A 500-MHz 150-kW SOLID-STATE POWER AMPLIFIER FOR HIGH ENERGY PHOTON SOURCE

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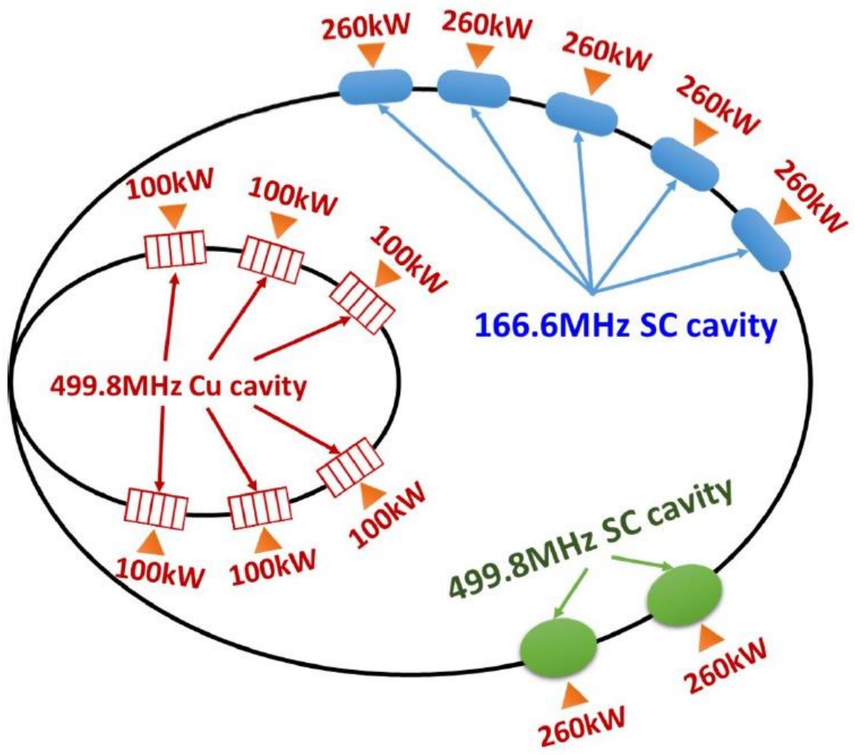
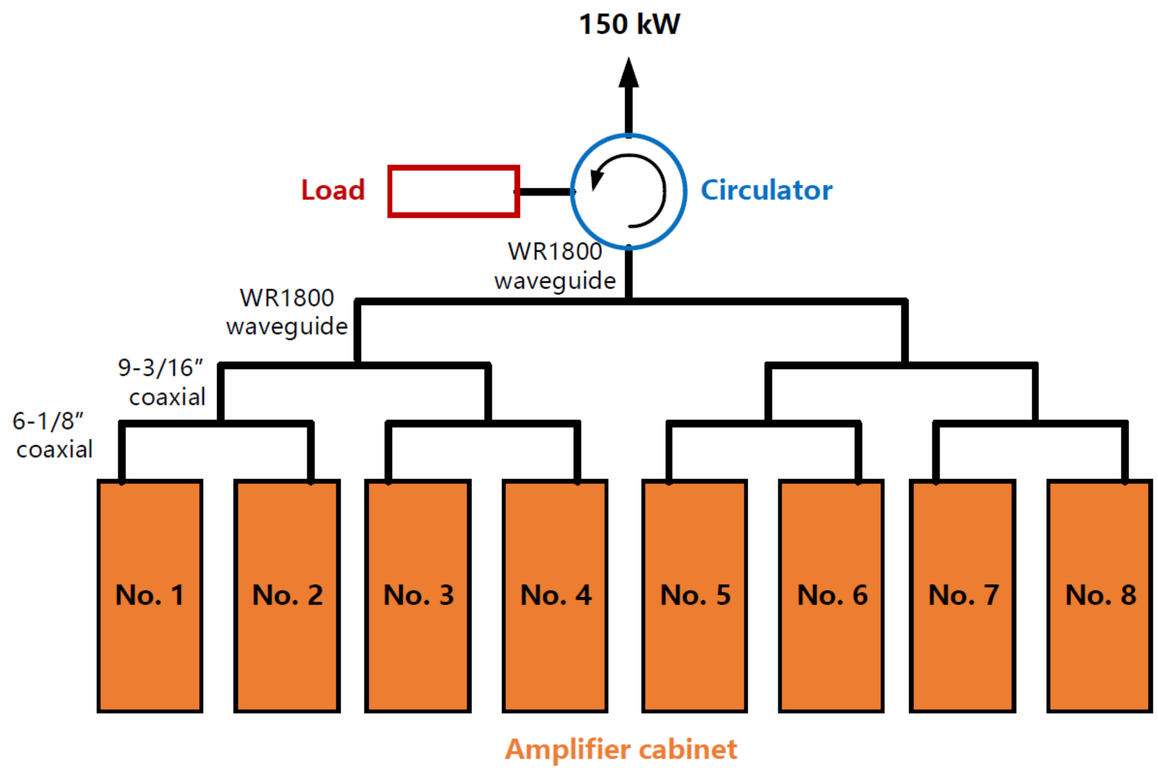
Abstract

A 500-MHz 150-kW solid-state power amplifier (SSA) has been developed to test the 500-MHz normal conducting cavities for High Energy Photon Source (HEPS) booster ring. It will also be used to power normal conducting cavities in the initial beam commissioning stage of the HEPS storage ring. A total number of 96 amplifier modules are combined initially by coaxial and later by waveguide combiners to deliver the 150-kW RF power. The final output is of EIA standard WR1800 rectangular waveguide. Each amplifier module consists four transistors equipped with individual circulator & load and outputs 2-kW RF power. Modularity, redundancy and satisfactory RF performance are demonstrated. In the final stage of HEPS project, this 150-kW amplifier will be modified to a 100-kW amplifier to join the other five 100-kW SSAs for normal operation of the booster cavities. The development and test results are presented in this paper.

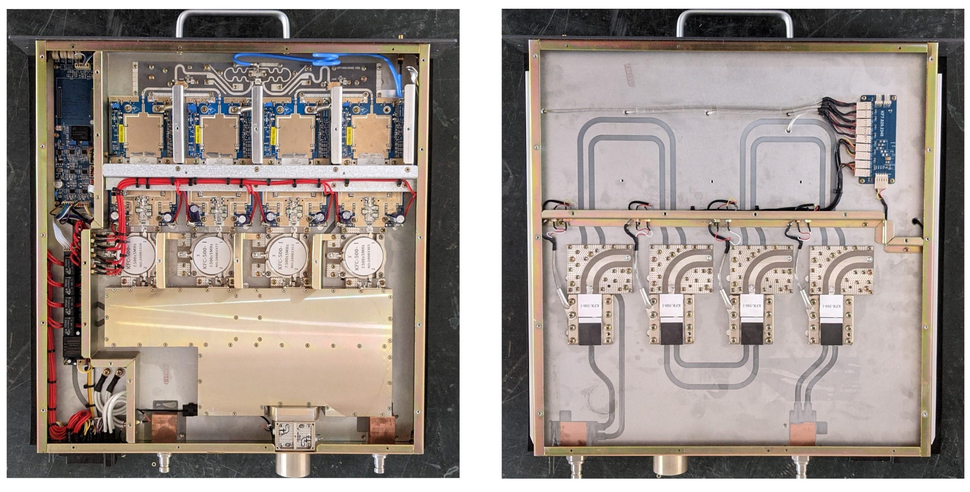
1. RF system of HEPS



2. 500-MHz 150-kW SSA combining route



3. 2-kW amplifier module

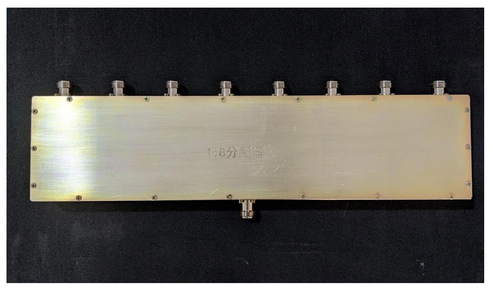


(a) (b)

The 2-kW amplifier module: (a) front side view and (b) back side view.

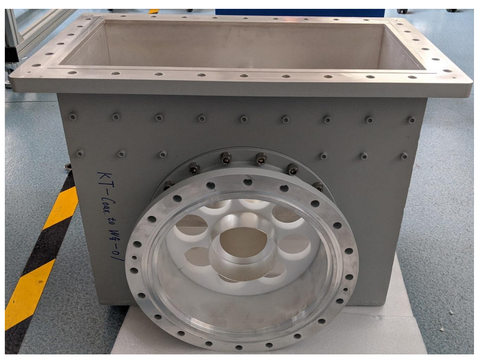
4. Thermal analysis

8-way power splitter



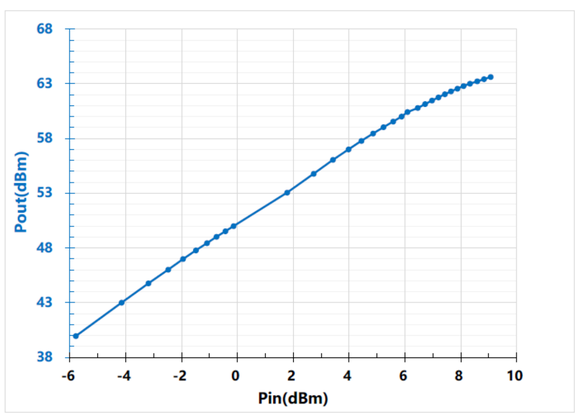
2-way junction power combiner

9-3/16" coaxial to waveguide

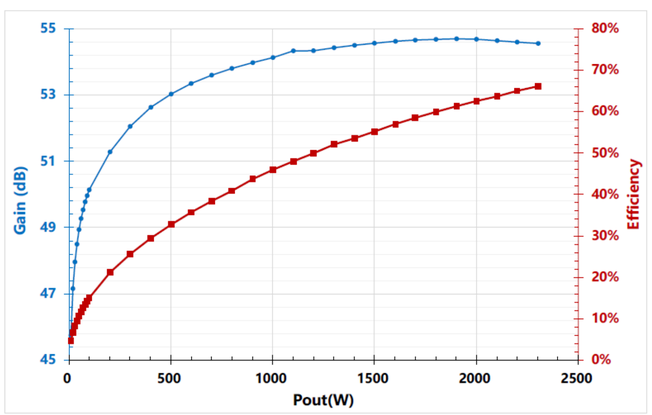


5. Test results of 2-kW amplifier module

Parameters	Test results
Frequency	499.8 MHz
P1dB	>2200 W
Amplitude error (p-p, 1 s)	±0.08%
Phase error (p-p, 1 s)	±0.12°
Harmonic	-30.7 dBc
Spurious within ±20 MHz	-79.6 dBc
Phase noise @10 Hz offset	-71.8 dBc/Hz
Efficiency (DC to RF)	65.0%



(a)



(b)

6. Test results of 150-kW SSA

Parameters	Test results
Frequency	499.8 MHz
P1dB	>22 kW
Harmonic	-34.4 dBc
Spurious within ±20 MHz	-72.6 dBc
Phase noise @10 Hz offset	-73.3 dBc/Hz
Efficiency (DC to RF)	49.2%