

RF Development Status at Iranian Light Source Facility (ILSF)

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ABSTRACT

The Iranian Light Source Facility (ILSF) RF system was conceptually designed in accordance with the requirements for ILSF 3GeV storage ring with 400mA beam current at 500 MHz RF frequency. The development of the solid state amplifiers initiated with the design and fabrication of two amplifier modules based on BLF578 and MRFE6VP1K25HR6 transistors and 690W and 630W stable RF power were delivered respectively. Combining of 8 such modules is under test to achieve 4kW output power as the first stage of the conceptually designed combining network. The measured characteristics are presented in this poster. Motivated by the development of HOM damped cavity with simpler structure at 100MHz at MAX Lab., 100MHz RF system is under exploration as an alternative to 500 MHz at ILSF. In addition to thorough study of the frequency change effects on the beam and machine parameters, the design of a 100MHz cavity based on MAX Lab. design has also been performed. Fabrication of a prototype cavity is planned in order to conclude the possibility of the cavity development in house. The development of a LLRF system and thermionic RF gun is also in progress but not presented here.

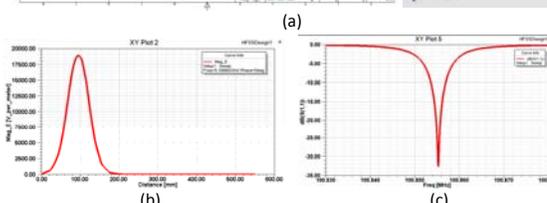
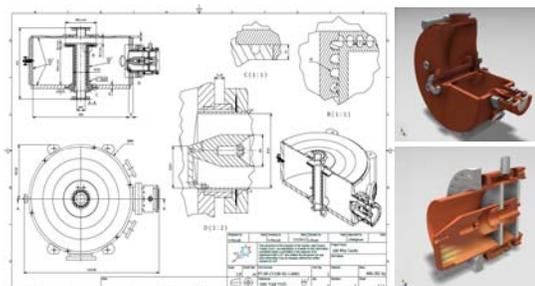
RF SYSTEM ALTERNATIVES

- ILSF Storage ring main parameters:
3GeV, 400mA current, 528m circumference, 477pm.rad emittance.

Parameters	500 MHz RF System (based on EU cavity)	100 MHz RF System (based on MAX cavity)
Total RF voltage (MV)	2.5	1.4
Harmonic number	880	176
RF Voltage/cavity (kV)	625	350
Number of cavities	4	4
Cavity Insertion length (m)	0.5	0.5
Cavity Insertion height (m)	1.6	0.9
HOM damping	✓	✓
Shunt Impedance (MΩ)	3.3	1.6
RF power/cavity (kW)	148 = (59+89)	127 = (38+89)
Amplifier Power (kW)	164	141
Transmission Line	Waveguide	Coaxial Line
SR tunnel space	1 straight section (5m)	1 straight section (5m)

100MHz Cavity

- Electromagnetic and mechanical designs are done. Cooling and stress calculations are under progress.

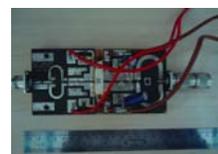
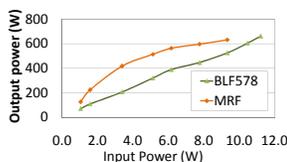


100 MHz RF cavity designed at ILSF based on MAX-Lab cavity .
(a) 2D and 3D mechanical drawings. (b) Longitudinal cavity E-field. (c) Cavity input coupler S11 response.

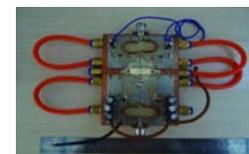
500MHz SOLID STATE AMPLIFIER

AMPLIFIER MODULES

Transistor part No.	Freq.	Max. power	Gain	Efficiency
BLF 578	500 MHz	692W (limited to driver)	17.7 dB	67%
MRFE6VP61K25HR6	500 MHz	630 W	18.3 dB	48.5% (Under optimization)



Amplifier Module
(Based on BLF578 Transistor)



Amplifier Module
(Based on MRFE6VP61K25HR6 Transistor)

- Combining 8 modules (2.2kW is achieved so far. It will be tested soon at higher power when the power supply with more protection is ready.)



8:1 Combiner

Maximum loss	0.1 dB in 10% BW
Return loss	20 dB
Minimum isolation	16 dB without isolation resistor
Amplitude imbalance	< ±0.05 dB
Phase imbalance	< ±1°



AC (3phase) / DC (60V)



Power supply and controller
(under development)

Technology used	Multiphase Synchronous Buck Converter
Protectors	Output Voltage, Input Current , Output Current, RF Power MOSFET Temperature, Case Temperature
Communication	Serial bus (RS485) - Addressable
Cooling	WATER
Control type	Output Current & Voltage
Switching frequency	100KHz
DC input	60 V – 25 A
DC output	50 V – 30 A
Line & load regulation	≤0.5
Ripple	< 4 %
Efficiency	>90%



New designed heat sink



Amplifier Module
(Based on BLF578 Transistor)



1:8 Divider

Simple power supplies with current limit are used for 2.2kW tests