High-Power Products & Large Scale Projects

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P100308341 Rev. 1.12 23.04.2024, C. Weil

Product Lists

AFT has provided many state-of-the-art CW-RF circulators and ferrite loads for the most renowned scientific institutes worldwide. For reference purpose the following table shows a list of selected AFT high-power products with cw RF and pulsed RF power, starting from 2003.

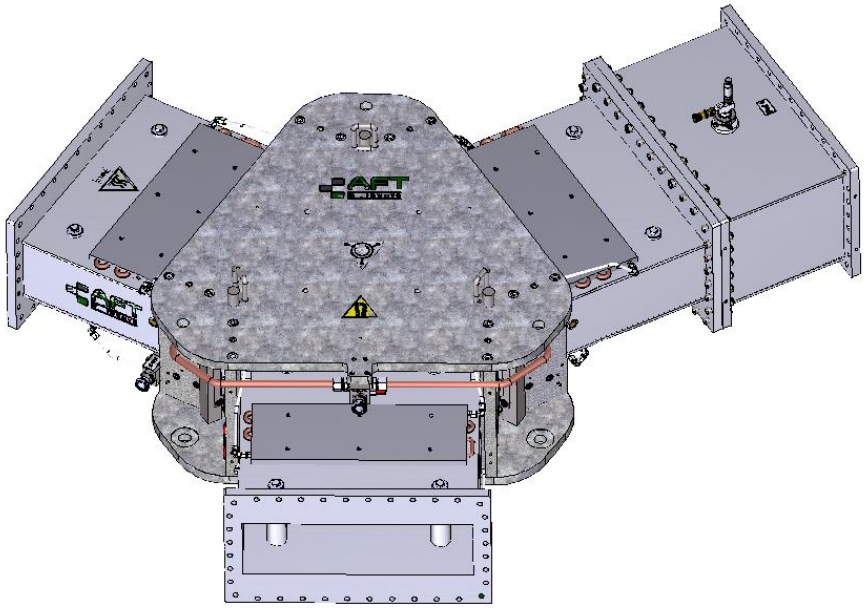

Fig. 1: High-Power Circulator 352MHz 1.3 MW_{cw} WR2300 (example)

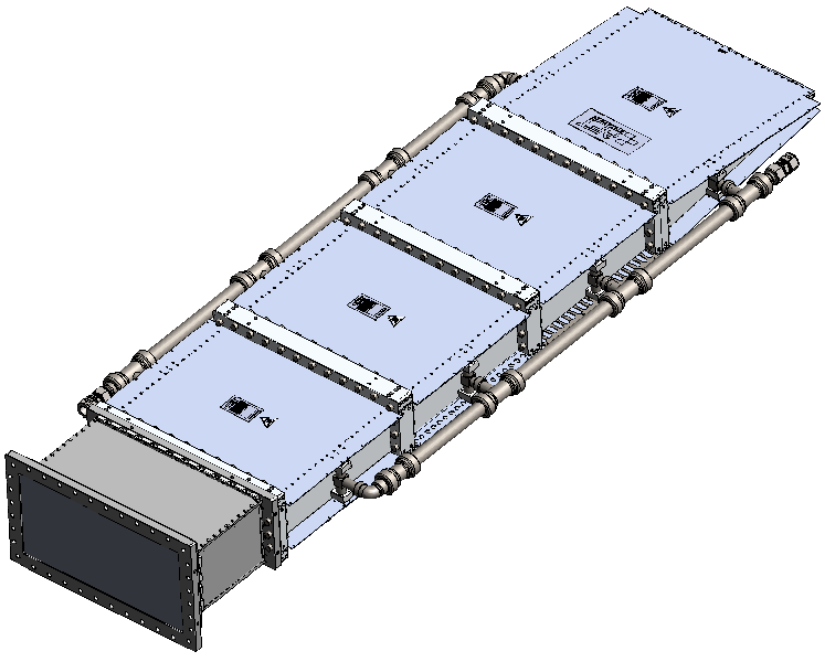

Fig. 2: High-Power Ferrite Load 352MHz 3 MW_{peak} 300kW_{avg} WR2300 (example)

Selected Product List – High-Power Circulators ≤ 1300 MHz

Product	Frequency [MHz]	Peak Power [kW]	Avg Power [kW]	Pulse Width [ms]	Waveguide	Country (Customer)	Year
Circulator	27.1	50	24	-	6 1/8" EIA	Germany	2016
Circulator	31.6	10	10	-	1 5/8" EIA	India	2003
Circulator	52.9	5	5		1 5/8" EIA	BNL, USA	2000
Circulator	56.3	7.5	7.5	-	1 5/8" EIA	BNL, USA	2022
Circulator	70	135	135	-	6 1/8" EIA	GER	2022
Isolator	75	25	25	-	3 1/8" EIA	IAP, GER	2016
Circulator	80.5	5	5	-	1 5/8" EIA	NSCL, USA	2010
Isolator	87.5	18	18	-	3 1/8" EIA	IAP, GER	2013
Circulator	88	10	10	-	3 1/8" EIA	GANIL, FRA	2011, 2021
Circulator	88	20	20	-	3 1/8" EIA	GANIL, FRA	2011
Circulator	88	60	60	-	6 1/8" EIA	GANIL, FRA	2011
Circulator	97	30	30	-	3 1/8" EIA	USA	2013
Circulator	100	30	30	-	3 1/8" EIA	MAXLAB, SWE	2005
Isolator	100	120	120	-	6 1/8" EIA	MAX IV, Solaris	2014
Circulator	100	120	120	-	6 1/8" EIA	MAX IV, SWE	2020
Circulator	100.6	400	4	-	4 1/16" EIA	BNL, USA	2014
Isolator	117	4	4	-	1 5/8" EIA	ANL, USA	2013
Circulator	118	32	32	-	3 1/8" EIA	Germany	2010
Circulator	118	80	80	-	6 1/8" EIA	Germany	2016
Circulator	162.5	200	200	-	9 3/16" EIA	China	2015
Circulator	165	150	100	-	6 1/8" EIA	Korea	2015
Isolator	175	14	14	-	3 1/8" EIA	France	2015
Circulator	175	135	135	-	6 1/8" EIA	Spain	2012
Circulator	175	250	250	-	9 3/16" EIA	Spain	2011
Circulator	187	75	75	-	4 1/16" EIA	LBNL, USA	2010
Circulator	199.6	20	20	-	3 1/8" EIA	USA	2011

Product	Frequency [MHz]	Peak Power [kW]	Avg Power [kW]	Pulse Width [ms]	Waveguide	Country (Customer)	Year
Circulator	200	200	20	1.5	6 1/8" EIA	KAERI, KOR	2014
Circulator	201	200	40	-	3 1/8"	LANL, USA	2024
Circulator	201	250	250	-	9 3/16"	CERN, SUI	2003
Circulator	216	10	10	-	1 5/8" EIA	ITA	2011
Circulator	322	100	100	-	6 1/8" EIA	USA	2013
Circulator	324	1000	100	-	WR2300	STFC, UK	2012
Circulator	324	3000	105	0.7	WR2300	CSNS, CHN	2013-2019
Circulator	325	600	600	-	WR2300	China	2013
Circulator	325	2000	70		WR2300	IHEP, China	2012
Circulator	325	3000	6	0.2	WR2300	FAIR GSI, GER	2013
Circulator	350	1300	1300	-	WR2300	KAERI, KOR	2013, 2020
Circulator	352	20	20	-	3 1/8" EIA	SCK-CEN, BEL	2019
Circulator	352	200	200	-	WR2300	ANL, USA	2024
Circulator	352	400	20	3.5	6 1/8" EIA	ESS, SWE	2017
Circulator	352	600	600	-	WR2300	CEA, FRA	2022
Circulator	352	1100	1100	-	WR2300	BARC, India	2013
Circulator	352	1300	1300	-	WR2300	CERN, SUI	1995
Circulator	352	1500	120	1.5	WR2300	CERN, SUI	2014
Circulator	352	1500	300	-	WR2300	Korea	2017
Circulator	352	2800	150	1.5	WR2300	ESS Bilbao, ESP	2012
Circulator	352	3200	240	1.5	WR2300	IPN, CEA, FRA	2013,2016
Circulator	352	3000	150	3.5	WR2300	ESS, SWE	2019
Circulator	400	330	330	-	WR2300	USA	2017
Circulator	400.8	330	330	-	WR2300	CERN, SUI	2003
Circulator	402.5	2500	200	1.3	WR2100	SNS, USA	2015-2022
Circulator	500	35	35	-	6 1/8" EIA	BNL, USA	2012
Circulator	500	80	80	-	6 1/8" EIA	LNLS, BRA BESSY, GER	2018,2020
Circulator	500	100	100	-	6 1/8" EIA	LBL, USA	2022

High-Power Products

Product	Frequency [MHz]	Peak Power [kW]	Avg Power [kW]	Pulse Width [ms]	Waveguide	Country (Customer)	Year
Circulator	500	140	140	-	WR1800	Elettra, ITA	2021
Circulator	500	150	150	-	9 3/16" EIA	DLS, UK	2018
Circulator	500	150	150	-	WR1500	NSTO, AUS	2006
Circulator	500	150	150	-	WR1800	DLS, UK	2020
Circulator	500	250	250	-	WR1800	SSRF, CHN	2011
Circulator	500	300	300	-	WR1800	LBNL, USA	2011
Circulator	500	350	350	-	WR1800	Synchrotrons worldwide	2017-2023
Circulator	508.6	1200	1200	-	WR1800	SPring8, Japan	2013, 2022
Circulator	591	600	600	-	WR1500	BNL, USA	2024
Circulator	650	800	800	-	WR1500	IHEP, CHN	2020
Circulator	700	100	100	-	WR1150	India	2011
Circulator	700	1000	1000	-	WR1500	BNL, USA	2005
Circulator	704	1500	100	2.6	WR1150	CERN, SUI	2014
Circulator	704	1500	75	3.5	WR1150	ESS, SWE	2018
Circulator	800.9	250	250	-	WR1150	CERN, SUI	2011
Circulator	805	5000	550	-	WR1150	SNS, USA	2003
Circulator	805	550	50	-	WR1150	SNS, USA	2003
Circulator	805	1000	90	1.5	WR1150	SNS, USA	2021, 2022
Circulator	805	12000	23	-	WR1150	FNAL, USA	2011
Isolator	1300	7	7	-	WR650	SLAC, USA	2023
Isolator	1300	10	10	-	WR650	Cornell, USA	2018
Circulator	1300	270	270	-	WR650	HZR Berlin, GER	2013
Circulator	1300	300	300	-	WR650	TRIUMPF, CAN	2013
Circulator	1300	400	5	-	WR650	DESY, GER	2005
Circulator	1300	5000	50	-	WR650	IPN, FRA	2010
Circulator	1300	5000	150	0.9	WR650	USA	2005
Circulator	1300	10000	10	-	WR650	China	2020
Isolator	1300	8	8	-	WR650	NCNR, Poland	2023

Selected Product List – High-Power Ferrite Loads ≤ 1300 MHz

Product	Frequency [MHz]	Peak Power [kW]	Avg Power [kW]	Pulse Width [ms]	Waveguide	Country (Customer)	Year
Ferrite Load	324	3000	105	0.7	WR2300	CSNS, CHINA	2013,2017
Ferrite Load	325	600	600	-	WR2300	ADS, CHINA	2013
Ferrite Load	325	3000	6	0.2	WR2300	FAIR GSI, GER	2012
Ferrite Load	350	1600	45	1.5	WR2300	KAERI, KOR	2012
Ferrite Load	350	1600	150	1.5	WR2300	KAERI, KOR	2016
Ferrite Load	352	280	280	-	WR2300	BARC, India	2013
Ferrite Load	352	400	20	3.5	6 1/8" EIA	ESS, SWE	2018
Ferrite Load	352	560	560	-	WR2300	BARC, India	2013
Ferrite load	352	1000	300	0.1	WR2300	CEA, FRA	2022
Ferrite Load	352	1500	75	-	WR2300	ESS, SWE	2019
Ferrite Load	352	2000	150	0.5	WR2300	USA	2022
Ferrite Load	352	2000	300	0.5	WR2300	USA	2022
Ferrite Load	352	2800	10	1.6	WR2300	CERN, SUI	2011-2013
Ferrite Load	352	3000	150	3.5	WR2300	ESS, SWE	2019
Ferrite Load	352	3000	240	3.7	WR2300	CEA, France	2013,2016
Ferrite Load	400.8	330	330	-	WR2300	CERN, SUI	2016
Ferrite Load	500	80	80	-	WR1800	ALBA CELLS	2020
Ferrite Load	500	120	120	-	WR1800	NSRRC, TW	2011, 2018
Ferrite Load	500	140	140	-	WR1800	Elettra, ITA	2021
Ferrite Load	500	150	150	-	WR1500	ANSTO, AUS	2005
Ferrite Load	500	150	150	-	WR1800	DLS, UK	2017, 2020
Ferrite Load	500	260	180	-	WR1500	ANSTO, AUS	2023
Ferrite Load	500	300	200	-	WR1800	LBNL, USA	2021
Ferrite Load	500	300	300	-	WR1800	LNLS, BRA	2018
Ferrite Load	500	350	350	-	WR1800	Synchrotrons worldwide	2011-2023
Ferrite Load	591	600	600	-	WR1500	BNL, USA	2024
Ferrite Load	650	400	400	-	WR1500	IHEP, China	2018

High-Power Products

Product	Frequency [MHz]	Peak Power [kW]	Avg Power [kW]	Pulse Width [ms]	Waveguide	Country (Customer)	Year
Ferrite Load	650	800	800	-	WR1500	IHEP, China	2020
Ferrite Load	704	1500	100	2.6	WR1150	CERN, SUI	2014
Ferrite Load	704	1500	74	3.5	WR1150	ESS ERIC	2016,2018
Ferrite Load	704	1800	100	3.6	WR1150	Thales, France	2023
Ferrite Load	805	900	80	-	WR1150	CPI, USA	2003
Ferrite Load	1300	10000	10	-	WR650	China	2019
Ferrite Load	1300	8	8	n.a.	WR650	NCNR, Poland	2023

Large Scale Projects – High-Power

AFT has proven records in successfully performing higher magnitude projects in the scientific world over the last decades. The below table shows the major projects since 2003.

Year	Quantity	Product	Customer, Country
2024-2025	4	Circulator 352MHz 200kW WR2300	ANL, USA
2023-2025	168	Isolator 1300MHz 7kWcw WR650	SLAC, USA
2022/2023	12	Isolator 1300MHz 8kWcw WR650	NCNR, POL
2021/2022	28	Circulator 805MHz 1MWp 90kW WR1150	ORNL SNS, USA
2021/2022	4	Circulator 352MHz 600kWcw WR2300	CEA, FRA
2021/2022	4	Ferrite Load 352MHz 1000kWp 300kW WR2300	CEA, FRA
2020-2022	5	Circulator 500MHz 140kWcw WR1800	Elettra, ITA
2020-2022	10	Ferrite Load 500MHz 140kWcw WR1800	Elettra, ITA
2019/2020	5	Circulator 352MHz 3MWp 150kW WR2300	ESS Bilbao
2019/2020	6	Ferrite Load 352MHz 3MWp 150kW WR2300	ESS Bilbao
2019/2020	6	Ferrite Load 352MHz 1.5MWp 75kW WR2300HH	ESS Bilbao
2019	2	Circulator 352MHz 3MWp 150kW WR2300	ESS ERIC, SWE
2019	2	Ferrite Load 352MHz 1.5MWp 150kW WR2300HH	ESS ERIC, SWE
2019	2	Ferrite Load 352MHz 3MWp 150kW WR2300	ESS ERIC, SWE
2018/2019	80	Circulator 704MHz 1.5MWp 74kW WR1150	ESS ERIC, SWE
2018	82	Ferrite Load 704MHz 1.5MWp 74kW WR1150	ESS ERIC, SWE
2017/2018	26	Circulator 352MHz 400kWp 20kW 6 1/8” EIA	ESS ERIC, SWE
2017/2018	28	Ferrite Load 352MHz 400kWp 20kW 6 1/8” EIA	ESS ERIC, SWE
2015	8	Isolator 100MHz 120kWcw 6 1/8” EIA	MAX IV, SWE
2013	6	Circulator 350MHz 1300kWcw WR2300	KAERI, Korea
2013	6	Ferrite Load 704MHz 1.5MWp 100kW WR1150	CERN, SUI
2010	40	Ferrite Load 352MHz 2.8MWp 10kW WR2300	CERN LINAC4, SUI
2007	4	Circulator 88MHz 60kWcw 6 1/8” EIA	GANIL, France
2006	10	Circulator 88MHz 20kWcw 3 1/8” EIA	GANIL, France
2006	10	Circulator 88MHz 10kWcw 3 1/8” EIA	GANIL, France
2003	73	Circulator 805MHz 5MWp/ 550kWp WR1150	ORNL SNS, USA

AFT Customer List –
Radiation Facilities and Synchrotron Light Sources Worldwide

AFT has supported the following research facilities worldwide with circulators and or ferrite loads for a safe protection of RF sources and for a stable and reliable system operation:

- ALBA CELLS, Spain
- Argonne National Laboratory (ANL), USA
- Australian Synchrotron (ANSTO), Australia
- Brookhaven National Laboratory (BNL), USA
- Canadian Light Source (CLS), Canada
- CEA Saclay, France
- CERN, Switzerland
- CSNS, China
- Deutsches Elektronen Synchrotron (DESY), Germany
- Diamond Light Source (DLS), UK
- Elettra Sincrotrone Trieste, Italy
- European Spallation Source (ESS), Sweden
- European Synchrotron Radiation Facility (ESRF), France
- Gesellschaft für Schwerionenforschung (GSI), FAIR, Germany
- Helmholtz Zentrum Berlin (BESSY), Germany
- Helmholtz Zentrum Dresden, Germany
- Institute of Basic Science (IBS), Korea
- Institute of High Energy Physics (IHEP), China
- Institute of Plasma Physics Hefei, China
- Korean Atomic Energy Institute (KAERI), Korea
- Karlsruhe Institute of Technology (KIT), Germany
- Lawrence Berkeley National Laboratory (LBL), USA
- Los Alamos National Laboratory (LANL), USA
- LNLS, Brazil
- MAX IV Lund University, Sweden
- MIT, USA
- National Center of Nuclear Research (NCNR), Poland
- National Synchrotron Radiation Research Center (NSRRC), Taiwan
- Oak Ridge National Laboratory (ORNL), USA
- Pohang Accelerator Laboratory (PAL), Korea

- PSI Swiss Light Source (SLS) Switzerland
- SCK-CEN, Belgium
- Shanghai Synchrotron Radiation Facility (SSRF), China
- SPRING-8, Japan
- Stanford Linear Accelerator Center (SLAC), USA
- SOLARIS, Poland

Industry

We are a world-wide leader in producing cutting-edge, reliable high-power circulators, isolator, loads and passive subsystems for a wide range of industrial applications, such as:

LINACs

S-band (2856MHz and 2998MHz) and X-band (9300MHz) powered Linear Particle Accelerators (LINACs) used in medical radiotherapy, security inspection, non-destructive testing, and sterilization.

Industrial Application of Microwaves

Microwave heating, drying and plasma application operated at 2450MHz and 915MHz.