PARAMETERS OF SPring-8

STORAGE RING

1. LATTICE

Unit cell type	Chasman-Green
Optics	Hybrid
Energy (GeV)	8
Number of cell normal	44
straight	4
Beam current (mA)	
single bunch	5
multi bunch	100
Number of stored electrons / positrons	
single bunch	1.5×10^{11}
multi bunch	3.0×10^{12}
Number of bunches	
single bunch	1
multi bunch	max 2436
Bending radius (m)	39.2718
Circumference (m)	1435.948
Revolution period (μ s)	4.79
Horizontal betatron tune	53.22
Vertical betatron tune	20.16
Synchrotron tune	0.01
Number of superperiod	4
Maximum horizontal beta (m)	34.63
Maximum vertical beta (m)	20.90
Maximum dispersion (m)	0.39
Natural chromaticity	
horizontal	-151.86
vertical	-36.67
Momentum compaction	1.460×10^{-4}
Relative energy spread σ_E ($\Delta E/E$)	1.094×10^{-3}
Synchrotron damping time (msec)	4.15
Horizontal betatron damping time (msec)	8.30
Vertical betatron damping time (msec)	8.31
Natural emittance (m・rad)	5.55×10^{-9}
Horizontal emittance (m・rad)	5.0×10^{-9}
Vertical emittance (m・rad 10% coupling)	5.0×10^{-10}
Horizontal full aperture (mm)	70
Vertical full aperture (mm)	40
Beam height from the floor (m)	
ring	1.2
experimental hall	1.4

2. MAGNET

DIPOLE

Number	88
Number of families	1
Number of turns per coil	14
Length (m)	2.804
Field strength (T)	0.679
Current (A)	1090
Current density (A / mm^2)	3.23
Gap (mm)	64.04

QUADRUPOLES

Number		480
Number of families		7
Number of turns per coil		24
Maximum current density (A / mm^2)		3.6 ～ 4.8
Bore diameter (mm)		85
Effective Length (mm)	Q1, Q10	0.35
	Q2	0.97
	Q3, Q6, Q8	0.51
	Q4, Q7	0.41
	Q5	0.51
	Q9	0.97
Maximum gradient (T / m)	Q1, Q10	17.0
	Q2	17.6
	Q3, Q6, Q8	17.4
	Q4, Q7	16.2
	Q5	17.1
	Q9	17.6
Maximum current (A)	Q1, Q10	536
	Q2	552
	Q3, Q6, Q8	544
	Q4, Q7	504

	Q5	533
	Q9	552

SEXTUPOLES

Number		336
Number of families		6
Number of turns per coil		19
Bore diameter (mm)		92
Maximum current density (A / mm^2)		4.29
Effective Length (m)	S1, S2, S3, S5, S6, S7	0.30
	S4	0.50
Maximum gradient (T / m^2)		420
Maximum current (A)		285

STEERERS

Number		569
Number of types		4
Effective Length (m)		
	STH1, 2, 3, 4, 5, 6, STV1, 2, 4, 6	0.22
	STV3, 5	0.19
Maximum field (T)	STH1, 3, 4, 6	0.14
	STH2, 5	0.15
	STV1, 2, 4, 6	0.067
	STV3, 5	0.05
Maximum current (A)		5
Gap (mm)	STH1, 3, 4, 6	72
	STH2, 5	63
	STV1, 2, 4, 6	102
	STV3, 5	130
Power (W)	STH1, 3, 4, 6	57
	STH2, 5	56
	STV1, 2, 4, 6	46
	STV3, 5	53

3. RF SYSTEM

Fundamental RF

Harmonic number	2436
Frequency (MHz)	508.58
RF wavelength (m)	0.58947
Revolution frequency (kHz)	208.78
Klystron type	E3732 (Toshiba)
Number of klystrons	4
Power output / klystron (MW)	1
Number of RF sections	4
Number of cavities	32
Cells /cavity	1
Total cavity length (m)	13.44
Beam aperture diameter of a cavity (mm)	100
R/Q (Ω) (including transit time factor)	155
Shunt impedance / cell (M Ω)	5.5
Total cavity impedance (M Ω)	176
Transit time factor	0.639
Coupling coefficient	1.8
Total loss in the arcs (MeV/turn)	9.23
Loss in insertion devices (MeV/turn)	3.2

Multi-bunch operation

Beam current (mA)	100
Peak voltage (MV)	13.9
Overvoltage ratio	1.12
Synchrotron tune	0.00662
Energy aperture	0.01
Bunch length (mm)	5.51 (σ), 13.0 (FWHM)
Bunch length(psec)	16.5 (σ), 38.9 (FWHM)
Total klystron power (MW)	2.4
Cavity wall loss / cell (kW)	34.3

Single-bunch operation

Beam current (mA)	5
Parasitic mode losses (MeV / turn)	0.5
Peak voltage (MV)	17
Over voltage ratio	1.31
Synchrotron tune	0.00904
Energy aperture	0.023
Bunch length (mm)	4.03 (σ), 9.35 (FWHM)
Bunch length (psec)	11.9 (σ), 28.0 (FWHM)
Total klystron power (MW)	1.7
Cavity wall loss / cell (kW)	50

4. SOURCE POINT DATA

HIGH β STRAIGHT SECTIONS

Number	19
Free length (m)	6.65
Horizontal beta (m)	24.0
Vertical beta (m)	11.9
Horizontal r.m.s. electron beam size (mm)	
	0.348 (σ), 0.820 (FWHM)

Vertical r.m.s. electron beam size with 10% coupling (mm)	0.078 (σ), 0.183 (FWHM)
Horizontal r.m.s. electron beam divergence (mrad)	0.015 (σ), 0.034 (FWHM)
Vertical r.m.s.beam divergence with 10% coupling (mrad)	0.007 (σ), 0.015 (FWHM)

LOW β STRAIGHT SECTIONS

Number	15
Free length (m)	6.65
Horizontal beta (m)	0.951
Vertical beta (m)	5.50
Horizontal r.m.s. electron beam size (mm)	0.069 (σ), 0.16 (FWHM)
Vertical r.m.s. electron beam size with 10% coupling (mm)	0.052 (σ), 0.12 (FWHM)
Horizontal r.m.s. electron beam divergence (mrad)	0.073 (σ), 0.17 (FWHM)
Vertical r.m.s.beam divergence with 10% coupling (mrad)	0.010 (σ), 0.02 (FWHM)

BENDING MAGNET

(14.69cm inside from the edge)	
Number (BM1, BM2)	6, 17
Horizontal beta (m) (BM1, BM2)	3.19, 2.10
Vertical beta (m) (BM1, BM2)	19.36, 18.22
Horizontal r.m.s. source beam size (mm) (BM1, BM2)	0.127 (σ), 0.142 (σ)
Vertical r.m.s. source size with 10% coupling (mm)	0.099 (σ), 0.096 (σ)
Horizontal r.m.s. source divergence (mrad) (BM1, BM2)	0.073 (σ), 0.104 (σ)
Vertical r.m.s. source divergence with 10% coupling (mrad)	0.005 (σ), 0.005 (σ)
Critical wavelength (A)	0.429
Critical photon energy (keV)	28.9

5. DIAGONOSTICS

DCCTs	1 or more
CT / WCMs	1 or more
Screen monitors	
Beam position monitors	432
Beam loss monitors	
Strip line electrodes	1 set or more
Beam scraper	
SR monitering system	
Bending magnet	1 or more
Insertion device	1 or more
SR beam line stabilization system	each beam line

SYNCHROTRON

1. LATTICE

Unit cell type	FODO
Beam energy(GeV)	
Injection	0.9-1.15
maximum	8
Beam current (mA)	Max. 10
Repetition rate (Hz)	1.0
Horizontal emittance (m・rad 10% coupling)	2.09×10^{-7}
Vartical emittance (m・rad 10% coupling)	2.09×10^{-8}
Energy spread σ_E ($\Delta E/E$)	1.26×10^{-3}
Circumference(m)	396.12
Number of cells / superperiods	40 / 2
Betatron tune ν_x / ν_z	11.73 / 8.78
Momentum compaction α_c	1.01×10^{-2}
Max. β_x / β_z(m)	16.7 / 17.9
Max. Dx (m)	1.0
Natural chromaticities ξ_x / ξ_z	-14.4 / -11.5
Harmonic number	672
Revolution time (μ sec)	1.32
Quantum life time (sec)	＞10
Damping times (8 GeV)	
$t_x / t_z / t_s$ (msec)	1.76 / 1.76 / 0.86

2. MAGNET

DIPOLES

Number	64
Number of families	1
Number of turns per coil	10
Length (m)	2.900

Field strength (T)	0.9034
Gap (mm)	40

QUADRUPOLES

Number	80
Number of families	2
Number of turns per coil	11
Bore diameter (mm)	80
Length (m)	0.60
Maximum gradient (T/m)	QF 14.598
	QD 12.374
Maximum current density (A/mm^2)	QF 7.55
	QD 6.40

SEXTUPOLES

Number	60
Number of families	2
Number of turns per coil	10
Bore diameter (mm)	100
Length (m)	0.15
Maximum gradient (T/m^2)	SF 101.6
	SD 162.5
Maximum current density (A/mm^2)	SF 5.18
	SD 8.28

STEERERS

Number	80
Length (m)	0.10
Maximum strength (T)	0.09

3. RF SYSTEM

Frequency (MHz)	508.58
Harmonic number	672
Energy loss / turn(MeV)	12.27
Revolution frequency (kHz)	756.8
Synchrotron frequency (kHz)	32.2
Peak Voltage (MV)	18.2
Shunt impedance / cell (M Ω)	6.19
Wall loss (kW / cell)	Max. 50
Number of cells per cavity	5
Number of cavities	8
Number of klystrons	2
Nominal klystron power (MW)	1
Max. cavity power (kW)	250

4. DIAGONOSTIC

DCCTs	1
CT / WCMs	1 / 1
Screen monitors	7
Beam position monitors	80
Beam loss monitors	40
Beam scraper	
Horizontal	1
Vertical	1
SR monitering system	1

LINAC

Energy (GeV)	
electron	1.15
positron	0.9
Repitation rate (Hz)	60
Frequency (MHz)	2856
Accelerator section	
structure	Traveling wave
mode	2 π / 3
number of cells	81
shunt impeadance (M Ω)	54
length (m)	2.835
energy gain per section (MeV)	45
klystron operation power (MW)	26
Current (mA)	
electron (1 μ s)	100
electron (1ns)	300
positron	10
Emittance (π mm・mrad 1 σ)	
electron	＜ 1.0
positron	＜ 1.5
Energy spread Δ E/E (%, 1 σ)	
electron	± 1.0
positron	± 1.5