2.4 Power supplies

2.4.1 Bending Magnet

RIMA-BX/BE Bending Magnet Power Supply (RIPS-B)

SPECIFICATIONS

Magnet Load	see magnet specifications	
Cabling	700 m (400 mm2)	R= 0.03 Ω
Power supply units	1	
Current (nominal) I_N	430 A	(490 A)
Current (minimal)	5 A	
Current gradient (max)	15 A/s	U_L= 51 V
Voltage	910 V	R_L= 2 Ω
Operating quadrants	1 Q	
- 3 dB control bandwidth	N/A	
Stability (8 h - 100 s) referred to I_N	15 ppm	
Stability (100 s - 100 ms) referred to I_N	15 ppm	
Stability (0 - 100 ms) referred to I_N	15 ppm	
Accuracy, absolute, referred to I_N	100 ppm	
Reproducibility long term	100 ppm	
Resolution reference value	15 ppm	

2.4.2 Quadrupole Magnet Power Supplies

a) Quadrupole Cabling Investigations

The cabling for the booster magnet feeds had been investigated for their power loss to air within the tunnel. From the lattice design, the quadrupole magnets could be grouped in families: 14, 22, 87 or 175 families would result, the latter representing individually supplied quadrupole magnets.

The cabling had been optimised for each solution with respect to minimise runs inside the tunnel and accounting for the respective run outside of the tunnel. The analysis is based on an average quadrupole magnet current of 100 A and a current density of 1 A/mm^2.

			14 families	22 families	87 families	174 families
Cabling	inside	[m]	2161	2261	2258	2256
	outside	[m]	5412	7882	4843	2436
Dissipated Power	inside	[kW]	3.9	4.0	4.0	4.0
	outside	[kW]	9.1	15.1	8.7	4.4

The variation of cable sizes with the associated splices and higher material cost has so far not been considered.

It has been decided, to implement the solution with an individual power supply for each quadrupole magnet.

All power supplies can be modulated up to 5 Hz with an current amplitude of ± 5 % of I_N to enable the beam based alignment (BBA) procedure. However, the power supplies will be for one quadrant operation only (no voltage reversal).

b) RIMA-Q.A/Q.E/Q.H Quadrupole Magnet Power Supply (RIPS-QA)

SPECIFICATIONS

Magnet Load	see magnet specifications QA-200	
Cabling	200 m (95 mm2)	R= 0.04 Ω
Power supply units	54	
Current (nominal) I_N	120 A	
Current (minimal)	1.2 A	
Current gradient (max)	N/A	
Voltage	60 V	R_L= 0.131 Ω
Operating quadrants	1 Q	w/o polarity changer
- 3 dB control bandwidth	for BBA only	< 5 Hz, < 5 % I_N
Stability (8 h - 100 s) referred to I_N	100 ppm	
Stability (100 s – 100 ms) referred to I_N	100 ppm	
Stability (0 - 100 ms) referred to I_N	100 ppm	
Accuracy, absolute, referred to I_N	100 ppm	
Reproducibility long term	100 ppm	
Resolution reference value	15 ppm	

c) RIMA-Q.B/Q.D/Q.G Quadrupole Magnet Power Supply (RIPS-QB)

SPECIFICATIONS

Magnet Load	see magnet specifications QB-320	
Cabling	200 m (95 mm2)	R= 0.04 Ω
Power supply units	54	
Current (nominal) I_N	120 A	
Current (minimal)	1.2 A	
Current gradient (max)	N/A	
Voltage	60 V	R_L= 0.173 Ω
Operating quadrants	1 Q	w/o polarity changer
- 3 dB control bandwidth	for BBA only	< 5 Hz, < 5 % I_N
Stability (8 h - 100 s) referred to I_N	100 ppm	
Stability (100 s - 100 ms) referred to I_N	100 ppm	
Stability (0 - 100 ms) referred to I_N	100 ppm	
Accuracy, absolute, referred to I_N	100 ppm	
Reproducibility long term	100 ppm	
Resolution reference value	15 ppm	

d) RIMA-Q.C/Q.F/Q.G Quadrupole Magnet Power Supply (RIPS-QC)

SPECIFICATIONS

Magnet Load	see magnet specifications QC-440	
Cabling	200 m (95 mm2)	R= 0.04 Ω
Power supply units	66	
Current (nominal) I_N	120 A	
Current (minimal)	1.2 A	
Current gradient (max)	N/A	
Voltage	60 V	R_L= 0.215 Ω
Operating quadrants	1 Q	w/o polarity changer
- 3 dB control bandwidth	for BBA only	< 5 Hz, < 5 % I_N
Stability (8 h - 100 s) referred to I_N	100 ppm	
Stability (100 s – 100 ms) referred to I_N	100 ppm	
Stability (0 - 100 ms) referred to I_N	100 ppm	
Accuracy, absolute, referred to I_N	100 ppm	
Reproducibility long term	100 ppm	
Resolution of reference value	15 ppm	

2.4.3 Sextupole Magnet Power Supplies

a) Sextupole Cabling Investigations

The sextupole magnets are grouped in 9 families. The associated cabling had been optimised to minimise the cable runs inside the tunnel. The power calculations are based on an average of 100 A and a current density of 1 A/mm^2 for each family.

			79 families
Cabling	inside	[m]	1496
	outside	[m]	3366
Dissipated Power	inside	[kW]	2.6
	outside	[kW]	5.9

No variation of cable sizes will be considered.

b) RIMA-SD/-SE/-SF Sextupole Magnet Power Supply (RIPS-SD, RIPS-SE, RIPS-SF)

RIPS-SE and RIPS-SF are identical with RIPS-SD.
SPECIFICATIONS

Magnet Load	see magnet specifications	
Cabling	700 m (95 mm2)	R= 0.13 Ω
Power supply units	3	
Current (nominal) I_N	120 A	
Current (minimal)	1.2 A	
Current gradient (max)	N/A	
Voltage	160 V	R_L= 1.176 Ω
Operating quadrants	1 Q	w/o polarity changer
- 3 dB control bandwidth	N/A	
Stability (8 h – 100 s) referred to I_N	100 ppm	
Stability (100 s - 100 ms) referred to I_N	100 ppm	
Stability (0 – 100 ms) referred to I_N	100 ppm	
Accuracy, absolute, referred to I_N	100 ppm	
Reproducibility long term	100 ppm	
Resolution reference value	15 ppm	

c) RIMA-SSA/-SSB Sextupole Magnet Power Supply (RIPS-SSA, RIPS-SSB)

RIPS-SSA and RIPS-SSB are identical.
SPECIFICATIONS

Magnet Load	see magnet specifications	
Cabling	700 m (95 mm2)	R= 0.13 Ω
Power supply units	2	
Current (nominal) I_N	120 A	
Current (minimal)	1.2 A	
Current gradient (max)	N/A	
Voltage	160 V	R_L= 0.588 Ω
Operating quadrants	1 Q	w/o polarity changer
- 3 dB control bandwidth	N/A	
Stability (8 h - 100 s) referred to I_N	100 ppm	
Stability (100 s - 100 ms) referred to I_N	100 ppm	
Stability (0 - 100 ms) referred to I_N	100 ppm	
Accuracy, absolute, referred to I_N	100 ppm	
Reproducibility long term	100 ppm	
Resolution reference value	15 ppm	

d) RIMA-SLA/-SLB/-SMA/-SMB Sextupole Magnet Power Supply (RIPS-SLA, RIPS-SLB, RIPS-SMA, RIPS-SMB)

RIPS-SLA, RIPS-SLB, RIPS-SMA and RIPS-SMB are all identical.

SPECIFICATIONS

Magnet Load	see magnet specifications	
Cabling	700 m (95 mm2)	R= 0.13 Ω
Power supply units	4	
Current (nominal) I_N	120 A	
Current (minimal)	1.2 A	
Current gradient (max)	N/A	
Voltage	160 V	R_L= 0.294 Ω
Operating quadrants	1 Q	w/o polarity changer
- 3 dB control bandwidth	N/A	
Stability (8 h - 100 s) referred to I_N	100 ppm	
Stability (100 s – 100 ms) referred to I_N	100 ppm	
Stability (0 - 100 ms) referred to I_N	100 ppm	
Accuracy, absolute, referred to I_N	100 ppm	
Reproducibility long term	100 ppm	
Resolution reference value	15 ppm	

2.4.4 Orbit Corrector Magnet Power Supplies

a) RIMA-CX/-CY Orbit Corrector Magnet Power Supplies (RIPS-CX, RIPS-CY)

SPECIFICATIONS

Magnet Load	see magnet specifications	
Cabling	200 m (4 mm2)	R= 0.88 Ω
Power supply units	144	
Current (nominal) I_N	7 A	
Current (minimal)	0 A	
Current gradient (max)	TBD A/s	U_L= TBD V
Voltage	30 V	R_L= TBD Ω
Operating quadrants	4 Q	
- 3 dB control bandwidth	1 kHz	small signal only <1 %
Stability (8 h - 100 s) referred to I_N	N/A	
Stability (100 s - 100 ms) referred to I_N	15 ppm	
Stability (0 - 100 ms) referred to I_N	15 ppm	
Accuracy, absolute, referred to I_N	1000 ppm	
Reproducibility long term	1000 ppm	
Resolution reference value	30 ppm	