

Power tables for room temperature part of HINS

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1. Power consumption in the bunchers of MEBT

	Voltage	P _{copper}	P _{beam}
Buncher1	173 kV	6.1 kW	0
Buncher2	139 kV	4 kW	0

The bunchers were designed outside FNAL and this table has been provided by the vendor.

2. Power consumption in the room temperature CH cavities.

Cavity number	design type	β geom.	β particle	Rsh MOhm	Veff MV	Φ_s deg	dW MeV	W MeV	P _{copper} kW	P _{beam} kW	P _{total} kW
1	1	0.0744	0.0729	10.45	0.1807	-90	0.000	2.5	3.1246	0	3.1246
2	2	0.0771	0.0741	10.55	0.277	-50	0.178	2.678	7.2729	1.78	9.0529
3	3	0.0804	0.0767	10.994	0.2994	-50	0.192	2.871	8.1536	1.92	10.074
4	4	0.0842	0.0795	11.15	0.3336	-50	0.214	3.085	9.9811	2.14	12.121
5	5	0.0882	0.0825	15.64	0.3877	-50	0.249	3.334	9.6107	2.49	12.101
6	5	0.0882	0.0861	16.96	0.459	-45	0.325	3.659	12.422	3.25	15.672
7	8	0.1015	0.0905	14.38	0.5929	-45	0.419	4.078	24.446	4.19	28.636
8	8	0.1015	0.0955	17.16	0.6061	-40	0.464	4.542	21.408	4.64	26.048
9	8	0.1015	0.1008	18.62	0.6387	-35	0.523	5.065	21.909	5.23	27.139
10	11	0.116	0.1064	17.78	0.6983	-33	0.586	5.651	27.425	5.86	33.285
11	11	0.116	0.1121	19.77	0.7412	-33	0.622	6.273	27.788	6.22	34.008
12	11	0.116	0.1181	20.31	0.8216	-33	0.689	6.962	33.236	6.89	40.126
13	14	0.1316	0.1244	20.88	0.9425	-33	0.790	7.752	42.543	7.9	50.443
14	14	0.1316	0.1308	22.12	0.9071	-33	0.761	8.513	37.198	7.61	44.808
15	16	0.1422	0.1368	22.59	0.94	-33	0.788	9.301	39.115	7.88	46.995
16	16	0.1422	0.1426	23.29	1.0172	-40	0.779	10.081	44.427	7.79	52.217
Total :									370.06	75.79	445.85

The table is based on the beam dynamic simulation performed at ANL with TRACK and the RF design of the cavities made at FNAL with MWS.

Parameters:

Design type – each cavity has been designed for specific particle velocity. The same design type means identical cavities.

β_{geom} - relative velocity of synchronous particle for which a particular cavity was designed

$\beta_{particle}$ - actual relative particle velocity passing through cavity. They all differ from β_{geom} because of changed beam dynamic concept.

R_{sh} – shunt impedance of cavity calculated with MWS for actual particle velocity.

V_{eff} – maximal voltage required for a cavity by beam dynamic, includes transit-time factor

Φ_s – phase of RF field when a synchronous particle crosses a cavity center.

dW – energy gain after each cavity $dW = V_{eff} \cdot \cos\phi_s$

W – kinetic energy after each cavity

P_{copper} – RF losses in the cavity walls $P_{copper} = V_{eff}^2 / R_{sh}$

P_{beam} – additional RF power needed for a cavity to compensate beam loading: $P_{beam} = I \cdot dW$,
where I – average beam current (assumed 10 mA for this table).