

DOUBLER DIPOLE AND QUADRUPOLE DESIGN FIELD SPECIFICATIONS

S. Snowdon

January 1979

INTEGRATED MULTIPOLe STRUCTURE OF E-SERIES DIPOLE (091878 KEYSTONED) ENDIM 01/079-1100

ORDER OF POLE	=	1	CALCULATIONAL MODE	=	4527.000 ¹	NUMBER OF LAYERS (IN)	=	1.00000 ³
HIGHEST MULTIPOLe ORDER	=	3.7500 ¹	CONDUCTOR CURRENT(A)	=	4527.000 ¹	REFERENCE RADIUS (IN)	=	1.00000 ³
INNER IRON RADIUS(IN)	=	3.7500 ¹	HORIZONTAL INCREMENT(IN)	=	.1000 ¹	ELLIPTICITY OF ENDS (IN)	=	.00000 ³

LAYER	TURNS FRC	WIDTH (IN)	HGTMAX (IN)	HGTMIN (IN)	ZURDEN (%AT/IN) (IN)	THETAS (DEG)	THETAf (DEG)	SPACER (IN)	RINNER (IN)	ROUTER (IN)	LENGTH (IN)	WRAP (IN)
1	35.0	0.000	3070	0.5550	.0440	297.898	1723	72.9576	.0018206	1.5000	1:8140	252.3110
2	1.0	0.000	3070	0.5550	.0440	297.898	1433	2.4179	.0012811	1.8350	2:1490	250.2280
3	20.0	0.000	3070	0.5550	.0440	297.898	2.4173	36.3939	.0012811	1.8350	2:1490	250.1310

N	NET FIELD HY (KG-IN) HX (KG-IN)	NET FIELD HY ((S-IN) HX (KG-IN))	MULTIPOLE COEFFICIENTS OF FIELD AT REFERENCE RADIUS HY (KG-IN) HX (KG-IN)			
1	11454.669255	0.000000	931.9.3114579	0.000000	2134.8545756	0.000000
2	-295698	0.000000	-7.221141	0.000000	6.922443	0.000000
3	1.192453	0.000000	-1.204938	0.000000	-0.012515	0.000000
4	5.027478	0.000000	5.029452	0.000000	-0.001985	0.000000
5	-13.813192	0.000000	-13.813155	0.000000	-0.00027	0.000000
6	4.170926	0.000000	4.170926	0.000000	-0.000206	0.000000
7	-0.944631	0.000000	-0.944631	0.000000	-0.000364	0.000000
8	0.080878	0.000000	0.080878	0.000000	-0.00082	0.000000
9	-0.035356	0.000000	-0.035356	0.000000	-0.00007	0.000000
10	-0.050026	0.000000	-0.050026	0.000000	-0.00003	0.000000
11					-0.00004	0.000000

X (IN)	NET FIELD HY (KG-IN) HX (KG-IN)	MEDIAN PLANE FIELD VERSUS DISTANCE HY ((G-IN) HX (KG-IN))	NORMALIZED FIELD HX/HY0
0.000	11454.669	0.000	1.000000
1.000	11454.666	0.000	1.000000
2.000	11454.660	0.000	1.000000
3.000	11454.655	0.000	1.000000
4.000	11454.664	0.000	1.000000
5.000	11454.698	0.000	1.000000
6.000	11454.743	0.000	1.000000
7.000	11454.711	0.000	1.000000
8.000	11454.355	0.000	1.000000
9.000	11454.143	0.000	1.000000
10.000	11454.073	0.000	1.000000
11.000	11454.399	0.000	1.000000
12.000	11454.097	0.000	1.000000
13.000	11454.567	0.000	1.000000
14.000	11454.095	0.000	1.000000
15.000	11454.730	0.000	1.000000
16.000	11454.302	0.000	1.000000
17.000	11454.613	0.000	1.000000
18.000	11454.365	0.000	1.000000
19.000	11454.705	0.000	1.000000
20.000	11454.337	0.000	1.000000
21.000	11454.655	0.000	1.000000
22.000	11454.212	0.000	1.000000
23.000	11454.595	0.000	1.000000
24.000	11454.242	0.000	1.000000
25.000	11454.565	0.000	1.000000
26.000	11454.207	0.000	1.000000
27.000	11454.547	0.000	1.000000
28.000	11454.179	0.000	1.000000
29.000	11454.507	0.000	1.000000
30.000	11454.240	0.000	1.000000
31.000	11454.478	0.000	1.000000
32.000	11454.206	0.000	1.000000
33.000	11454.535	0.000	1.000000
34.000	11454.237	0.000	1.000000
35.000	11454.465	0.000	1.000000
36.000	11454.208	0.000	1.000000
37.000	11454.537	0.000	1.000000
38.000	11454.241	0.000	1.000000
39.000	11454.479	0.000	1.000000
40.000	11454.205	0.000	1.000000
41.000	11454.536	0.000	1.000000
42.000	11454.238	0.000	1.000000
43.000	11454.467	0.000	1.000000
44.000	11454.210	0.000	1.000000
45.000	11454.539	0.000	1.000000
46.000	11454.243	0.000	1.000000
47.000	11454.471	0.000	1.000000
48.000	11454.206	0.000	1.000000
49.000	11454.538	0.000	1.000000
50.000	11454.239	0.000	1.000000
51.000	11454.468	0.000	1.000000
52.000	11454.202	0.000	1.000000
53.000	11454.535	0.000	1.000000
54.000	11454.235	0.000	1.000000
55.000	11454.464	0.000	1.000000
56.000	11454.208	0.000	1.000000
57.000	11454.533	0.000	1.000000
58.000	11454.241	0.000	1.000000
59.000	11454.470	0.000	1.000000
60.000	11454.204	0.000	1.000000
61.000	11454.532	0.000	1.000000
62.000	11454.235	0.000	1.000000
63.000	11454.463	0.000	1.000000
64.000	11454.207	0.000	1.000000
65.000	11454.531	0.000	1.000000
66.000	11454.238	0.000	1.000000
67.000	11454.466	0.000	1.000000
68.000	11454.211	0.000	1.000000
69.000	11454.530	0.000	1.000000
70.000	11454.244	0.000	1.000000
71.000	11454.472	0.000	1.000000
72.000	11454.207	0.000	1.000000
73.000	11454.529	0.000	1.000000
74.000	11454.240	0.000	1.000000
75.000	11454.468	0.000	1.000000
76.000	11454.213	0.000	1.000000
77.000	11454.527	0.000	1.000000
78.000	11454.244	0.000	1.000000
79.000	11454.471	0.000	1.000000
80.000	11454.207	0.000	1.000000
81.000	11454.526	0.000	1.000000
82.000	11454.240	0.000	1.000000
83.000	11454.465	0.000	1.000000
84.000	11454.213	0.000	1.000000
85.000	11454.524	0.000	1.000000
86.000	11454.246	0.000	1.000000
87.000	11454.473	0.000	1.000000
88.000	11454.209	0.000	1.000000
89.000	11454.523	0.000	1.000000
90.000	11454.242	0.000	1.000000
91.000	11454.462	0.000	1.000000
92.000	11454.215	0.000	1.000000
93.000	11454.522	0.000	1.000000
94.000	11454.245	0.000	1.000000
95.000	11454.471	0.000	1.000000
96.000	11454.208	0.000	1.000000
97.000	11454.521	0.000	1.000000
98.000	11454.244	0.000	1.000000
99.000	11454.470	0.000	1.000000
100.000	11454.210	0.000	1.000000

UPC 045

INTEGRATED MULTIPOLE STRUCTURE OF E-SERIES DIPOLE(091878 KEYSTONED) ENDEN 01/079 - 11/00

ORDER OF POLE	1	CALCULATIONAL MODE	= 4527.000	NUMBER OF LAYERS	= 1.000
HIGHEST MULTIPOLE ORDER	19	CONDUCTOR CURRENT(A)	= 0.000	REFERENCE RADIUS (IN)	= 1.000
INNER IRON RADIUS (IN)	3.7500	HORIZONTAL INCREMENT (IN)	= .1000	ELLIPTICITY OF ENDS (IN)	= .0000

LAYER	TURNS	FBC	WIDTH (IN)	HGTMAX (IN)	GURDEN ((A/IN)/IN)	THETAS (DEG)	THETAF (DEG)	SPACER (IN)	RINNER (IN)	ROUTER (IN)	LENGTH (IN)	WRAP (IN)
1	35.0	0.000	3070	.0550	.0440	297.898	1723	72.9576	.0018206	1.5000	1.8140	.0035
2	21.0	0.000	3070	.0550	.0440	297.898	1433	2.4179	.0112811	1.8350	2.1490	.0035
3	20.0	0.000	3070	.0550	.0440	297.898	2.4179	36.3939	.0012811	1.8350	2.1490	.0035

MULTIPOLE COEFFICIENTS OF FIELD AT REFERENCE RADIUS
HY ((K₃-IN) HX (KG-IN))

N	45.	0.05338	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
1	45.	0.029754	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
3	45.	0.014013	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
5	45.	0.007007	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
7	45.	0.004897	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
9	45.	0.004896	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
11	45.	0.004896	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
13	45.	0.004896	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
15	45.	0.003760	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
17	45.	0.003331	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000
19	45.	0.003331	0.000000	36.	516731	0.000000	8.388546	0.000000	1.000000	0.000000	0.000000	0.000000

MEDIAN PLANE FIELD VERSUS DISTANCE
AIR FIELD HY ((KG-IN) HX (KG-IN))

X (IN)	NET FIELD HY ((KG-IN) HX (KG-IN))	HY ((KG-IN) HX (KG-IN))										
0.000	45.005	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000
1.000	45.005	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000
2.000	45.007	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000
3.000	45.008	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000
4.000	45.011	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000	36.5167	0.000
5.000	45.014	0.000	36.5168	0.000	36.5168	0.000	36.5168	0.000	36.5168	0.000	36.5168	0.000
6.000	45.018	0.000	36.5169	0.000	36.5169	0.000	36.5169	0.000	36.5169	0.000	36.5169	0.000
7.000	45.023	0.000	36.5201	0.000	36.5201	0.000	36.5201	0.000	36.5201	0.000	36.5201	0.000
8.000	45.028	0.000	36.5212	0.000	36.5212	0.000	36.5212	0.000	36.5212	0.000	36.5212	0.000
9.000	45.031	0.000	36.5203	0.000	36.5203	0.000	36.5203	0.000	36.5203	0.000	36.5203	0.000
10.000	45.028	0.000	36.5194	0.000	36.5194	0.000	36.5194	0.000	36.5194	0.000	36.5194	0.000
11.000	45.014	0.000	36.5191	0.000	36.5191	0.000	36.5191	0.000	36.5191	0.000	36.5191	0.000
12.000	44.976	0.000	36.4229	0.000	36.4229	0.000	36.4229	0.000	36.4229	0.000	36.4229	0.000
13.000	44.893	0.000	36.4367	0.000	36.4367	0.000	36.4367	0.000	36.4367	0.000	36.4367	0.000
14.000	44.720	0.000	36.4277	0.000	36.4277	0.000	36.4277	0.000	36.4277	0.000	36.4277	0.000
15.000	44.351	0.000	35.900	0.000	35.900	0.000	35.900	0.000	35.900	0.000	35.900	0.000

MAX. FIELD ON IRON(KG) = 15.0088 IRON PERMEABILITY AT 3 MAXFE= 432.8202 FLUX IN IRON(KG-IN) = 15.0088

FLUX IN IRON(KG-IN) = 63.8578

DTX (EMX=0.0MUIN EMY=0.0MUIN) DTY (EMX=0.0MUIN EMY=0.0MUIN)

+1.00
0
-.10/-1.00

0
+.10/.+1.00

+1.00
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-.10/-1.00

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+1.00
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-.10/-1.00

-3-

INTEGRATED MULTIPOLE STRUCTURE OF 2-SHELL SECTOR QUAD(100577 WIRE) ENDIM 011079-1400
 ORDER OF POLE = 2
 HIGHEST MULTIPOLE ORDER = 26
 INNER IRON RADIUS(IN) = 4.0000

CALCULATIONAL MODE = 4527.0000
 CONDUCTOR CURRENT(A) = .1000
 HORIZONTAL INCREMENT(IN) = .1000
 NUMBER OF LAYERS = 1
 REFERENCE RADIUS(IN) = 1.0000
 ELLIPTICITY OF ENDS(IN) = 0.0000

LAYER TURNS FRC	WIDTH (IN)	HGT MAX (IN)	HGT MIN (IN)	SURDEN (IN)	THETAS (DEG)	THEIAF (DEG)	SPACER (IN)	RINNER (IN)	ROUTER (IN)	LENGTH (IN)	WRAP (IN)
1 8.0 0.000	* 3070	* 0550	* 0440	297.898	19.485	14.4403	0.0000000	1.7500	2.0670	67.4580	.0050
2 6.0 0.000	* 3070	* 0550	* 0440	297.898	19.427	30.2032	0.0000000	1.7500	2.0670	67.4580	.0050
3 1.0 0.000	* 3070	* 0550	* 0440	297.898	1.9511	31.9511	0.0050000	2.0880	2.4050	66.9530	.0050
4 19.0 0.000	* 3070	* 0550	* 0440	297.898	0.7839	30.7839	0.0000000	2.0880	2.4050	66.9530	.0050

MULTIPOLE COEFFICIENTS OF FIELD AT REFERENCE RADIUS

N	HY(KG-IN) HX(KG-IN)	HY(KG-IN) HY(KG-IN)	HY(KG-IN) HZ(KG-IN)	
2	1354.907878	0.000000	1259.072397	0.000000
6	-0.033884	0.000000	-0.032705	0.000000
10	-0.252705	0.000000	-0.252735	0.000000
14	-0.97805	0.000000	-0.97835	0.000000
18	-0.004081	0.000000	-0.004091	0.000000
22	-0.000759	0.000000	-0.000752	0.000000
26	-0.000013	0.000000	-0.000013	0.000000

MEDIAN PLANE FIELD VERSUS DISTANCE

X(IN)	HY(KG-IN) HZ(KG-IN)	HY(KG-IN) HY(KG-IN)	HY(KG-IN) HX(KG-IN)	
0.000	0.000	0.000	0.000	
1.000	135.491	0.000	125.907	0.000
2.000	270.982	0.000	251.815	0.000
3.000	406.472	0.000	377.722	0.000
4.000	541.963	0.000	503.526	0.000
5.000	577.452	0.000	529.235	0.000
6.000	612.942	0.000	575.439	0.000
7.000	648.421	0.000	691.316	0.000
8.000	683.800	0.000	807.219	0.000
9.000	719.379	0.000	833.033	0.000
10.000	754.958	0.000	860.738	0.000
11.000	789.537	0.000	903.435	0.000
12.000	824.116	0.000	940.132	0.000
13.000	858.695	0.000	976.829	0.000
14.000	893.274	0.000	1014.526	0.000
15.000	927.853	0.000	1052.223	0.000
16.000	962.432	0.000	1090.910	0.000
17.000	1000.000	0.000	1128.597	0.000
18.000	1037.579	0.000	1166.284	0.000
19.000	1075.158	0.000	1204.981	0.000
20.000	1113.737	0.000	1242.678	0.000
21.000	1151.316	0.000	1279.375	0.000
22.000	1188.895	0.000	1317.072	0.000
23.000	1226.474	0.000	1354.769	0.000
24.000	1264.053	0.000	1391.466	0.000
25.000	1301.632	0.000	1428.163	0.000
26.000	1339.211	0.000	1464.860	0.000
27.000	1376.790	0.000	1501.557	0.000
28.000	1414.369	0.000	1538.254	0.000
29.000	1451.948	0.000	1575.951	0.000
30.000	1489.527	0.000	1613.648	0.000
31.000	1527.096	0.000	1651.345	0.000
32.000	1564.675	0.000	1689.042	0.000
33.000	1602.254	0.000	1726.739	0.000
34.000	1639.833	0.000	1764.436	0.000
35.000	1677.412	0.000	1802.133	0.000
36.000	1715.091	0.000	1839.830	0.000
37.000	1752.670	0.000	1877.527	0.000
38.000	1789.249	0.000	1915.224	0.000
39.000	1826.828	0.000	1952.921	0.000
40.000	1864.407	0.000	1989.618	0.000
41.000	1902.086	0.000	2026.315	0.000
42.000	1939.665	0.000	2063.992	0.000
43.000	1977.244	0.000	2101.679	0.000
44.000	2014.823	0.000	2139.366	0.000
45.000	2052.402	0.000	2176.993	0.000
46.000	2089.981	0.000	2214.680	0.000
47.000	2127.560	0.000	2252.367	0.000
48.000	2165.139	0.000	2289.054	0.000
49.000	2202.718	0.000	2326.741	0.000
50.000	2239.297	0.000	2364.428	0.000

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INTEGRATED MULTIPOLE STRUCTURE OF 2-SHELL SECTOR QUAD(100577 WIRE) ENDIM
011079 - 1400

4
= 1.0000
= 0.0000

ORDER OF POLE = 2
HIGHEST MULTIPOLE ORDER = 26
INNER IRON RADIUS(IN) = 4.0000

LAYER	TURNS	FBC	WIDTH (IN)	HGTMAX (IN)	HGTMIN (IN)	CURDEN (IN)	THETAS (DEG)	THETAF (DEG)	SPACER (IN)	RINNER (IN)	ROUTER (IN)	LENGTH (IN)	WPAP (IN)
1	8.0	0.000	.3070	.0550	.0440	.297-.898	19.4855	14.4403	0.000000	1.7500	2.0670	1.0000	.0050
2	6.0	0.000	.3070	.0550	.0440	.297-.898	1.9511	30.2032	0.000000	1.7500	2.0670	1.0000	.0050
3	5.0	0.000	.3070	.0550	.0440	.297-.898	30.7839	0.000000	2.0880	2.4050	2.4050	1.0000	.0050
4	19.0	0.000	.3070	.0550	.0440	.297-.898							

MULTIPOLE COEFFICIENTS OF FIELD AT REFERENCE RADIUS

N	HY(KG-IN)	HX(KG-IN)										
2	19.665733	0.000000	18.273705	0.000000	1.392028	0.000000	1.000000	0.000000	1.000000	0.000000	0.000000	0.000000
6	-0.004507	0.000000	-0.004525	0.000000	-0.000015	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000
10	-0.003608	0.000000	-0.003628	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000
14	-0.001466	0.000000	-0.001466	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000
18	-0.000059	0.000000	-0.000059	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000
22	-0.000011	0.000000	-0.000011	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000
26	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000

MEDIAN PLANE FIELD VERSUS DISTANCE

X(IN)	NET FIELD HY(KG-IN)	NET FIELD HX(KG-IN)	HY(KG-IN)	HX(KG-IN)								
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.000	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067
2.000	3.933	3.933	3.933	3.933	3.933	3.933	3.933	3.933	3.933	3.933	3.933	3.933
3.000	5.900	5.900	5.900	5.900	5.900	5.900	5.900	5.900	5.900	5.900	5.900	5.900
4.000	7.865	7.865	7.865	7.865	7.865	7.865	7.865	7.865	7.865	7.865	7.865	7.865
5.000	9.833	9.833	9.833	9.833	9.833	9.833	9.833	9.833	9.833	9.833	9.833	9.833
6.000	11.800	11.800	11.800	11.800	11.800	11.800	11.800	11.800	11.800	11.800	11.800	11.800
7.000	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767
8.000	15.734	15.734	15.734	15.734	15.734	15.734	15.734	15.734	15.734	15.734	15.734	15.734
9.000	17.701	17.701	17.701	17.701	17.701	17.701	17.701	17.701	17.701	17.701	17.701	17.701
10.000	19.668	19.668	19.668	19.668	19.668	19.668	19.668	19.668	19.668	19.668	19.668	19.668
11.000	21.635	21.635	21.635	21.635	21.635	21.635	21.635	21.635	21.635	21.635	21.635	21.635
12.000	23.581	23.581	23.581	23.581	23.581	23.581	23.581	23.581	23.581	23.581	23.581	23.581
13.000	25.537	25.537	25.537	25.537	25.537	25.537	25.537	25.537	25.537	25.537	25.537	25.537
14.000	27.492	27.492	27.492	27.492	27.492	27.492	27.492	27.492	27.492	27.492	27.492	27.492
15.000	29.450	29.450	29.450	29.450	29.450	29.450	29.450	29.450	29.450	29.450	29.450	29.450
16.000	31.366	31.366	31.366	31.366	31.366	31.366	31.366	31.366	31.366	31.366	31.366	31.366

MAX. FIELD ON IRON(KG) = 11.1493

IRON PERMEABILITY AT 3MAXFE= 916.2841

FLUX IN IRON(KG-IN) = 22.2462

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