

Helmholtz-Spulenpaar HHS 5230-100

Helmholtz Coil Pair HHS 5230-100



Technische Daten:		Specifications:
Kantenlänge:	3 m	<i>Square Side Length:</i>
Windungszahl (pro Spule):	100	<i>Number of turns (per Coil):</i>
Maximaler Spulenstrom:	16 A / 5 min.	<i>Maximum Coil Current:</i>
Spulenstrom, nominell:	8 A cont.	<i>Nominal Coil Current:</i>
Spulenabstand einstellbar:	D > 1.13 m	<i>Coil Spacings:</i>
Spulenabstand für beste Feldhomogenität:	D = 1.8 m	<i>Coil Spacing for best Field Uniformity:</i>
Max. Magn. Feldstärke:	650 A/m @ D=1.8 m	<i>Maximum Magnetic Field Strength:</i>
Magn. Nennfeldstärke:	325 A/m @ D=1.8 m	<i>Nominal Magnetic Field Strength:</i>
Magn. Feldstärke bei 1 A Spulenstrom:	50.8 A/m @ D=1.13 m 37.6 A/m @ D=2 m 10.3 A/m @ D=5 m	<i>Magnetic Fieldstrength, 1 A Coil Current:</i>
Erforderlicher Strom für 1 A/m:	19.7 mA @ D=1.13 m 26.6 mA @ D=2 m 97.1 mA @ D=5 m	<i>Current required for 1 A/m:</i>
Abmessungen:	W: 2.0 x H: 3.10 x B: 3.18	<i>Mechanical Dimensions:</i>
Bodenabstand:	0.12 m	<i>Ground Clearance:</i>
Anschlüsse: Laborbuchsen mit kombinierter Flügelklemme	4 mm	<i>Terminals: 4 mm female with universal wing terminal</i>
Nutzbarer Frequenzbereich:	DC - 5 kHz	<i>Usable Frequency Range:</i>
Induktivität (pro Spule):	100 mH	<i>Inductance (per Coil):</i>
Wirkwiderstand (pro Spule):	6 Ω	<i>Resistance (per Coil):</i>
Windungskapazität (pro Spule):	1.4 nF	<i>Coil Capacitance (per Coil):</i>
Resonanzfrequenz (pro Spule):	> 10 kHz, typ. 13 kHz	<i>Resonant Frequency (per Coil):</i>
Gewicht: (pro Spule):	190 kg	<i>Weight (per Coil):</i>

Anwendung:

Das Helmholtz-Spulenpaar eignet sich zur Erzeugung exakt definierter magnetischer Felder von DC bis etwa 5 kHz z.B. nach SAE J551-17. Die erzeugte Feldstärke steht in streng linearem Zusammenhang zum Spulenstrom. Aus der Spulengeometrie, dem Strom und der Windungszahl lässt sich die resultierende Feldstärke exakt analytisch (oder auch numerisch) berechnen. Die HHS 5230-100 ist aufgrund ihrer Größe ideal für Störfestigkeitsprüfungen gegen Magnetfelder im Automotive Bereich einsetzbar. Aufgrund der großzügig dimensionierten Bewicklung lassen sich (kurzzeitig) magnetische Felder über 800 A/m erzeugen. Typische Anwendungsfälle sind Immunitätsprüfungen an ganzen Fahrzeugen nach SAEJ551-17 (Vehicle Electromagnetic Immunity – Power Line Magnetic Fields). Bei der Felderzeugung mit Helmholtzspulen ist die magnetische Feldstärke streng proportional zum Spulenstrom. Letztendlich lässt sich die Kalibrierung der Magnetfeldstärke auf eine Strommessung (oder z.B. auf den Spannungsabfall an einem bekannten Vorwiderstand) zurückführen. Die Helmholtzspule selbst muss nicht kalibriert werden. Alternativ kann die Feldstärke auch mit Hilfe einer kleinen Feld-Sensorspule bestimmt werden.

Inbetriebnahme:

Der Aufbau der Spule erfolgt nach der Anleitung „Montageanleitung Helmholtz-Spulenpaar HHS 5230“

Die Helmholtzspule sollte in ausreichendem Abstand von möglichen Magnetfeldquellen (z.B. Transformatoren in Netzteilen von Messgeräten, stromdurchflossene Leiter, Bildschirme, Oszillografenröhren, Elektromotore, Lautsprecher uvm...) auf einem glatten tragfähigen Boden positioniert werden. Alle magnetischen Metallteile (d.h. Eisen / Stahl, Kobalt und Nickel) sollten aus der unmittelbaren Spulumgebung entfernt werden. Die Anschlussleitungen vom Generator zur Helmholtzspule sollten verdrillt werden, um unerwünschte Einkopplungen magnetischer Flüsse zu vermeiden. Die Klemmen der Spule 1 sind mit Kennbuchstaben A und B, die Klemmen der Spule 2 mit C und D gekennzeichnet. Beim Betrieb der Spulen ist darauf zu achten, dass alle 4 Klemmen in eine Richtung zeigen, andernfalls entsteht in Spulenmitte eine Magnetfeld-Auslöschung.

Application:

The Helmholtz-Coils are especially designed to generate precisely defined magnetic fields from DC to ca. 5 kHz, e.g. according to SAE J551-17. The generated fields are in a strongly linear relation to the coil current. The field strength can be calculated exactly by analytical (or numerical) methods, based on the coils' geometry, the number of turns and the coil current. Therefore the HHS 5230-100 is ideally suited for immunity testing against magnetic fields in the automotive sector. Due to the generously dimensioned winding packets it is possible to generate magnetic fields up to approx. 800 A/m for short times. Typical applications are magnetic immunity testing to whole vehicles according to SAEJ551-17 (Vehicle Electromagnetic Immunity – Power Line Magnetic Fields). When generating magnetic fields with Helmholtz coils the coil current is directly proportional to the magnetic field strength.

The calibration of the magnetic field is finally traceable to a current measurement (or to a voltage drop across a known resistor). The Helmholtz Coil itself does not require a calibration. Alternatively a small loop sensor can be used to determine the actual field strength.

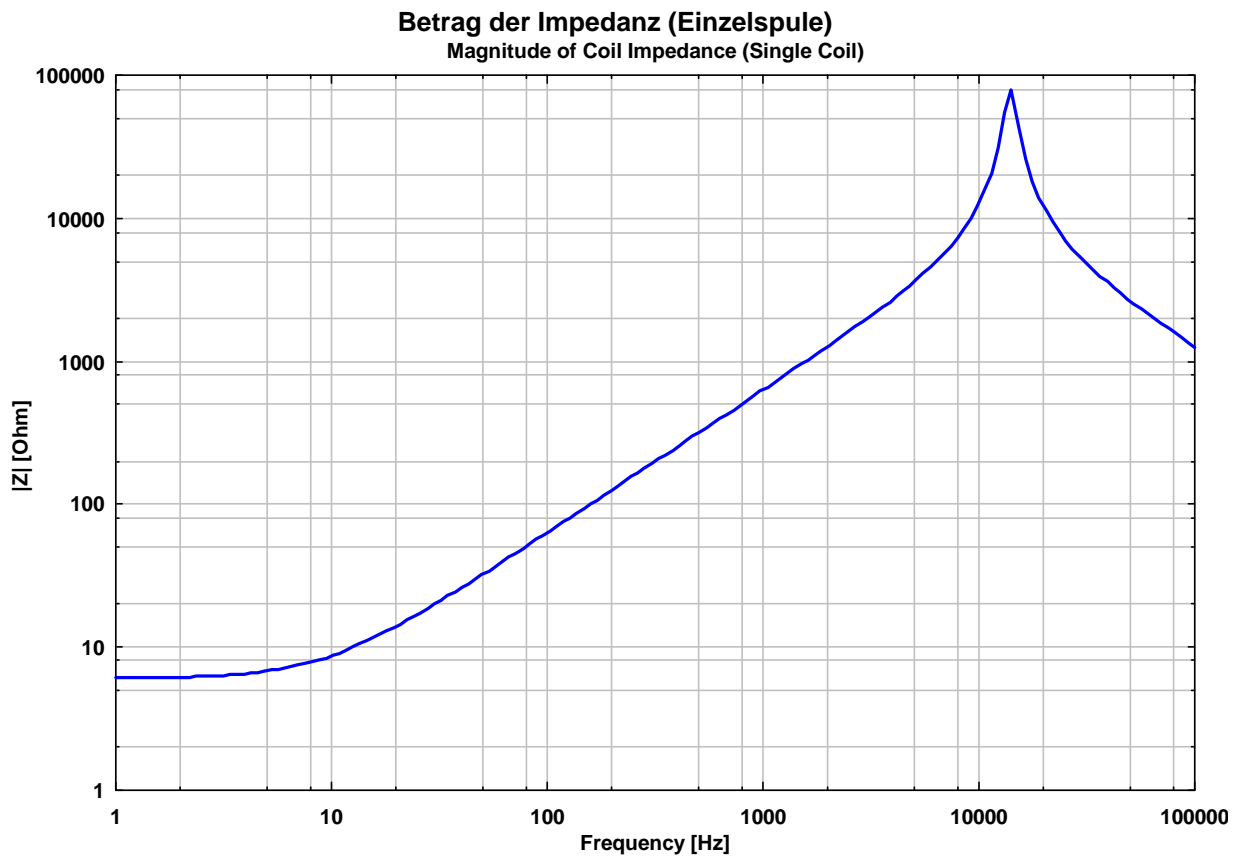
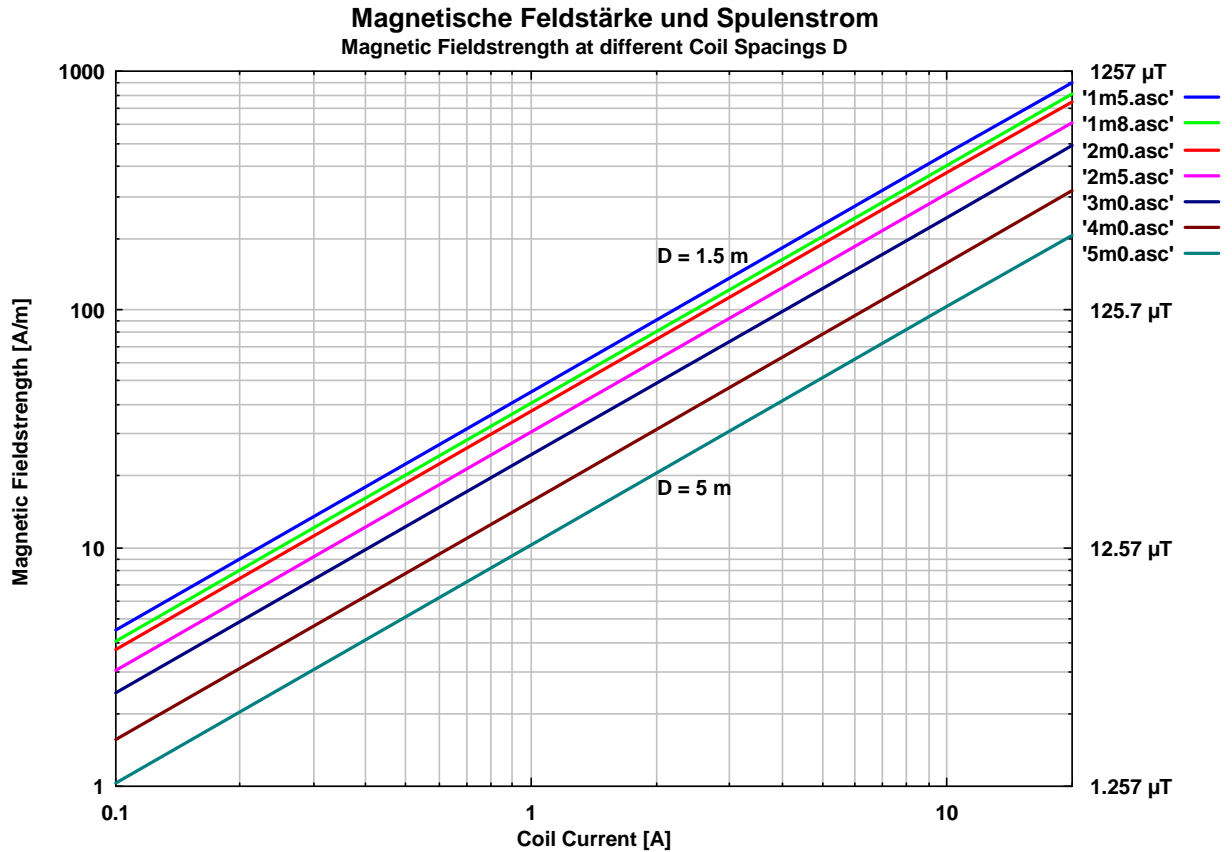
Installation:

The setup of the coils is described in the following part of the manual: “Assembly Instructions for Helmholtz Coil Pair HHS 5230”

The Helmholtz-Coils should be installed on the floor in a sufficiently large separation from sources of unintentional magnetic fields, e.g. transformers in power supplies, conductors carrying high currents, computer monitors, loudspeakers, cathode ray tubes (CRT) and more.... All kind of magnetic material (e.g. steel, Nickel, Cobalt) should be removed from the near surrounding of the coil. The wires which are used to connect the current source with the Helmholtz-Coil should be twisted to avoid an unwanted injection of magnetic flux.

The coil terminals are assigned with the characters A, B, C and D.

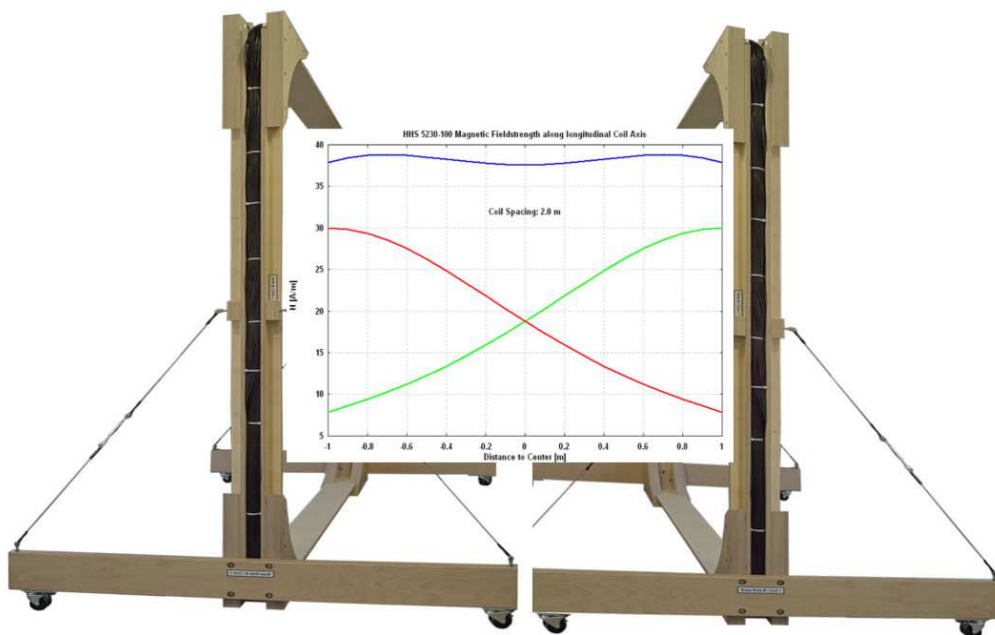
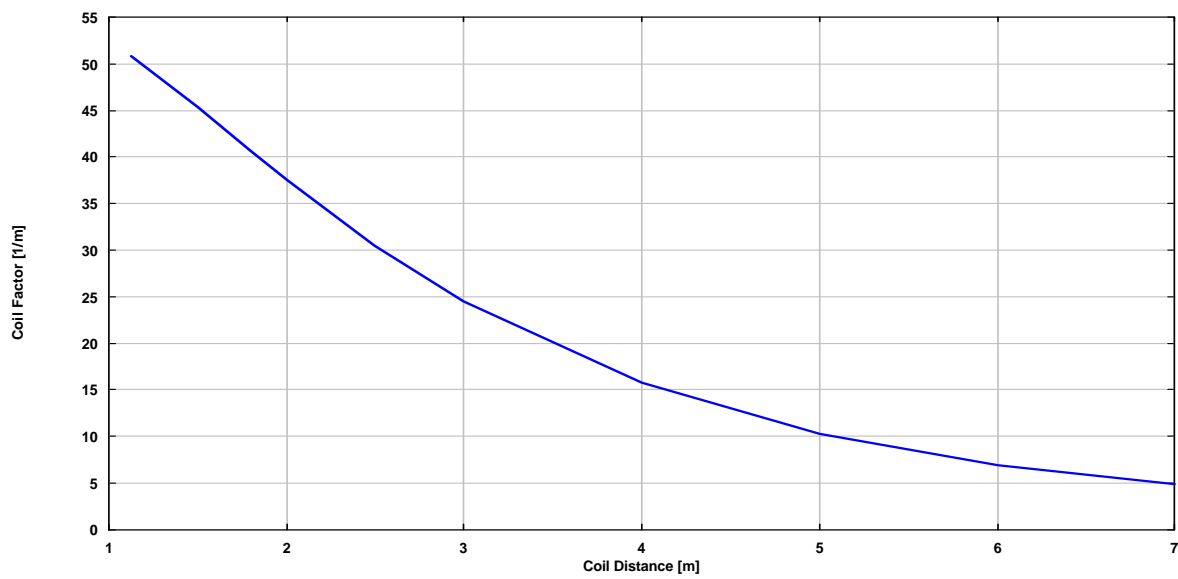
During operation of the coils the terminals must show in one direction. Otherwise there will be a deletion of the magnetic field in the middle between the coils.

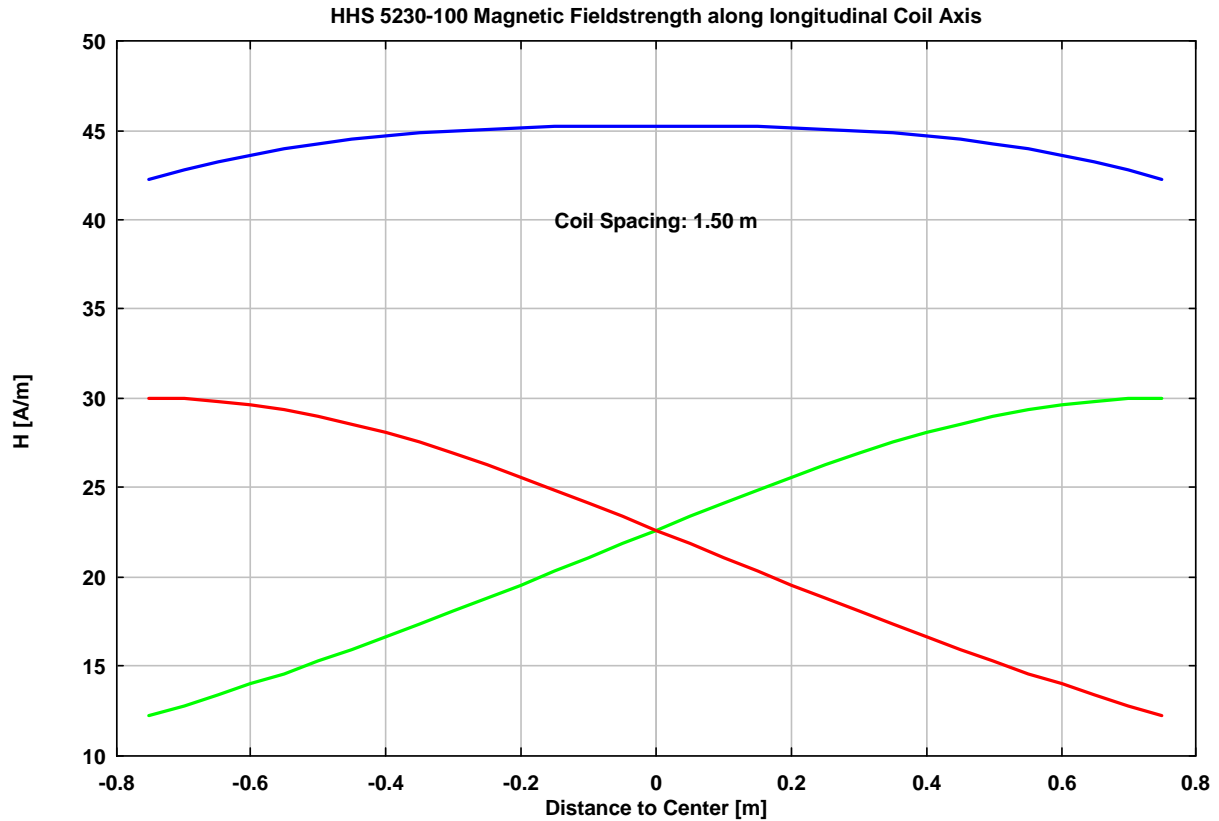


Coil factors for different coil separations:

Coil Separation [m]	Coil Factor ¹ [1/m]	Coil Factor ¹ [dB 1/m]
1.13	50.79	34.1
1.5	45.27	33.1
1.8	40.63	32.2
2.0	37.59	31.5
2.5	30.52	29.7
3.0	24.50	27.8
4.0	15.72	23.9
5.0	10.28	20.2
6.0	6.93	16.8
7.0	4.83	13.7

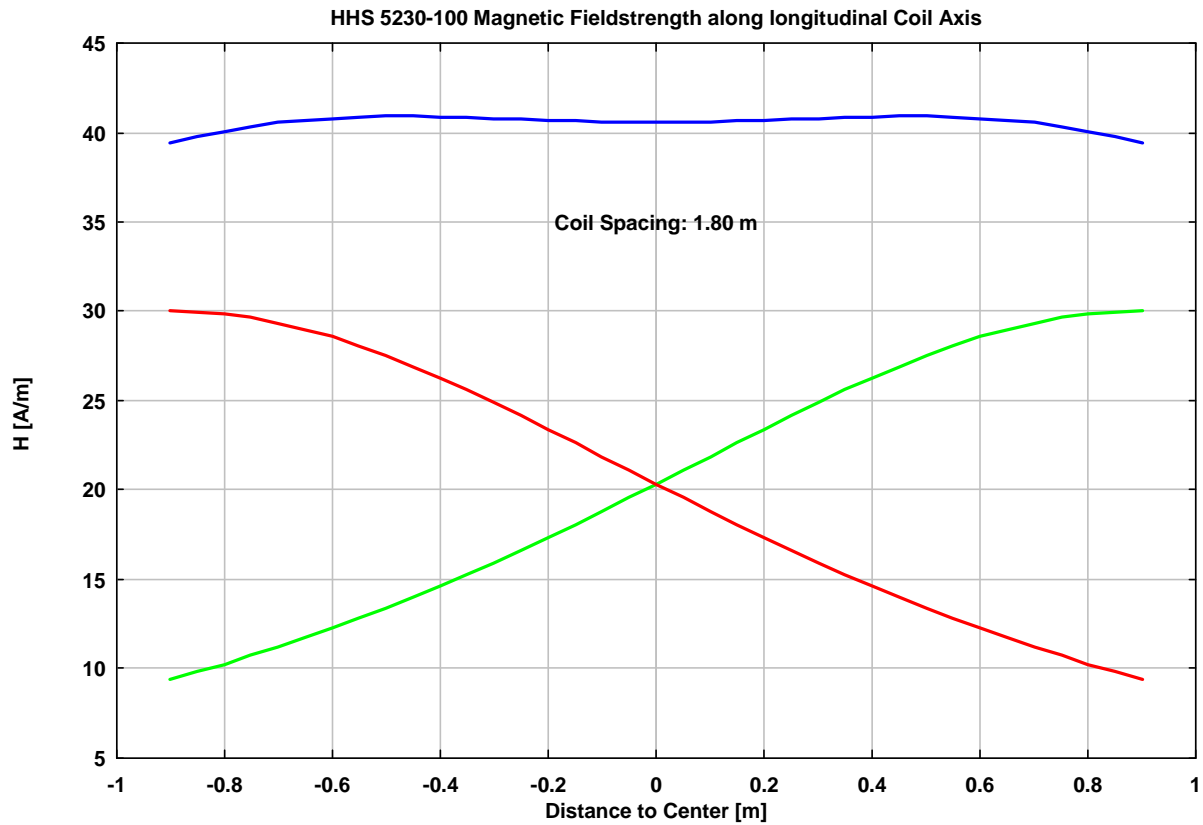
¹ The magnetic field strength is measured in the middle between the Helmholtz coils.





Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse <i>Magnet. Fieldstrength, longitudinal component along rotational axis</i>						
Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dBµA/m	H2 dBµA/m	Htot dBµA/m
0.00	22.6354	22.6354	45.2707	147.10	147.10	153.12
0.05	23.4025	21.8617	45.2641	147.39	146.79	153.12
0.10	24.1575	21.0863	45.2439	147.66	146.48	153.11
0.15	24.8945	20.3139	45.2085	147.92	146.16	153.10
0.20	25.6073	19.5483	45.1556	148.17	145.82	153.09
0.25	26.2891	18.7931	45.0822	148.40	145.48	153.08
0.30	26.9333	18.0511	44.9843	148.61	145.13	153.06
0.35	27.5329	17.3248	44.8577	148.80	144.77	153.04
0.40	28.0813	16.6163	44.6977	148.97	144.41	153.01
0.45	28.5720	15.9273	44.4993	149.12	144.04	152.97
0.50	28.9988	15.2590	44.2578	149.25	143.67	152.92
0.55	29.3562	14.6124	43.9685	149.35	143.29	152.86
0.60	29.6394	13.9880	43.6274	149.44	142.92	152.80
0.65	29.8446	13.3864	43.2310	149.50	142.53	152.72
0.70	29.9689	12.8077	42.7766	149.53	142.15	152.62
0.75	30.0105	12.2517	42.2623	149.55	141.76	152.52

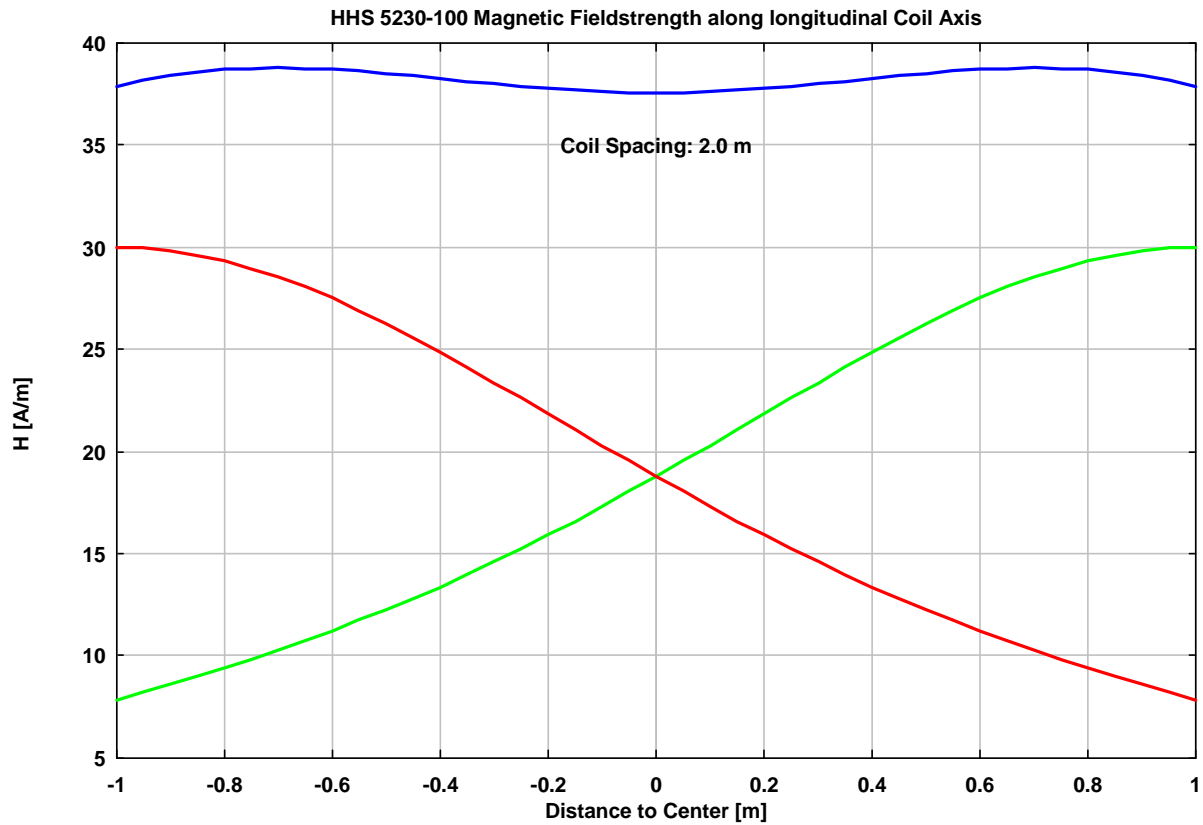
Spulenstrom: 1 A, Spulenabstand: 1.5 m
Coil Current: 1 A, Coil Separation: 1.5 m



Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse
Magnet. Fieldstrength, longitudinal component along rotational axis

Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dB μ A/m	H2 dB μ A/m	Htot dB μ A/m
0.00	20.3139	20.3139	40.6278	146.16	146.16	152.18
0.05	21.0864	19.5483	40.6347	146.48	145.82	152.18
0.10	21.8617	18.7931	40.6547	146.79	145.48	152.18
0.15	22.6354	18.0511	40.6864	147.10	145.13	152.19
0.20	23.4025	17.3248	40.7273	147.39	144.77	152.20
0.25	24.1575	16.6163	40.7738	147.66	144.41	152.21
0.30	24.8945	15.9273	40.8219	147.92	144.04	152.22
0.35	25.6073	15.2590	40.8663	148.17	143.67	152.23
0.40	26.2891	14.6124	40.9015	148.40	143.29	152.23
0.45	26.9333	13.9880	40.9213	148.61	142.92	152.24
0.50	27.5329	13.3864	40.9193	148.80	142.53	152.24
0.55	28.0813	12.8077	40.8890	148.97	142.15	152.23
0.60	28.5720	12.2517	40.8237	149.12	141.76	152.22
0.65	28.9988	11.7185	40.7173	149.25	141.38	152.20
0.70	29.3562	11.2077	40.5638	149.35	140.99	152.16
0.75	29.6394	10.7187	40.3581	149.44	140.60	152.12
0.80	29.8446	10.2513	40.0959	149.50	140.22	152.06
0.85	29.9689	9.8046	39.7735	149.53	139.83	151.99
0.90	30.0105	9.3782	39.3887	149.55	139.44	151.91

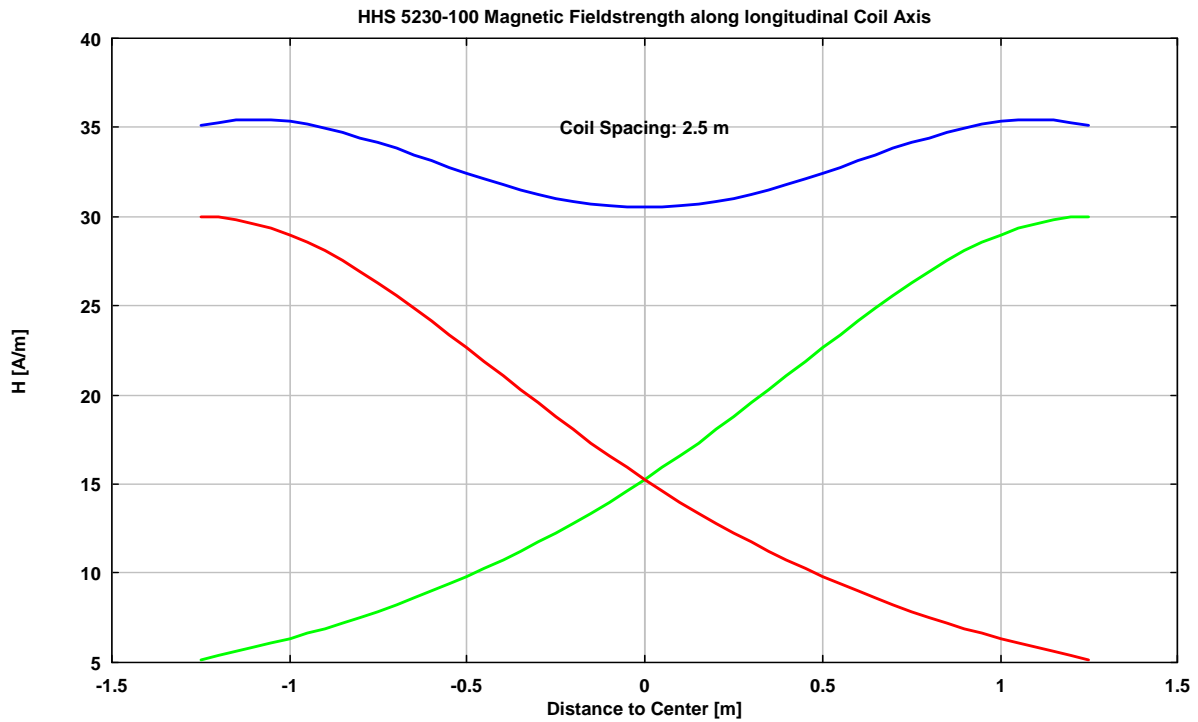
Spulenstrom: 1 A, Spulenabstand: 1.8 m
Coil Current: 1 A, Coil Separation: 1.8 m



Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse
Magnet. Fieldstrength, longitudinal component along rotational axis

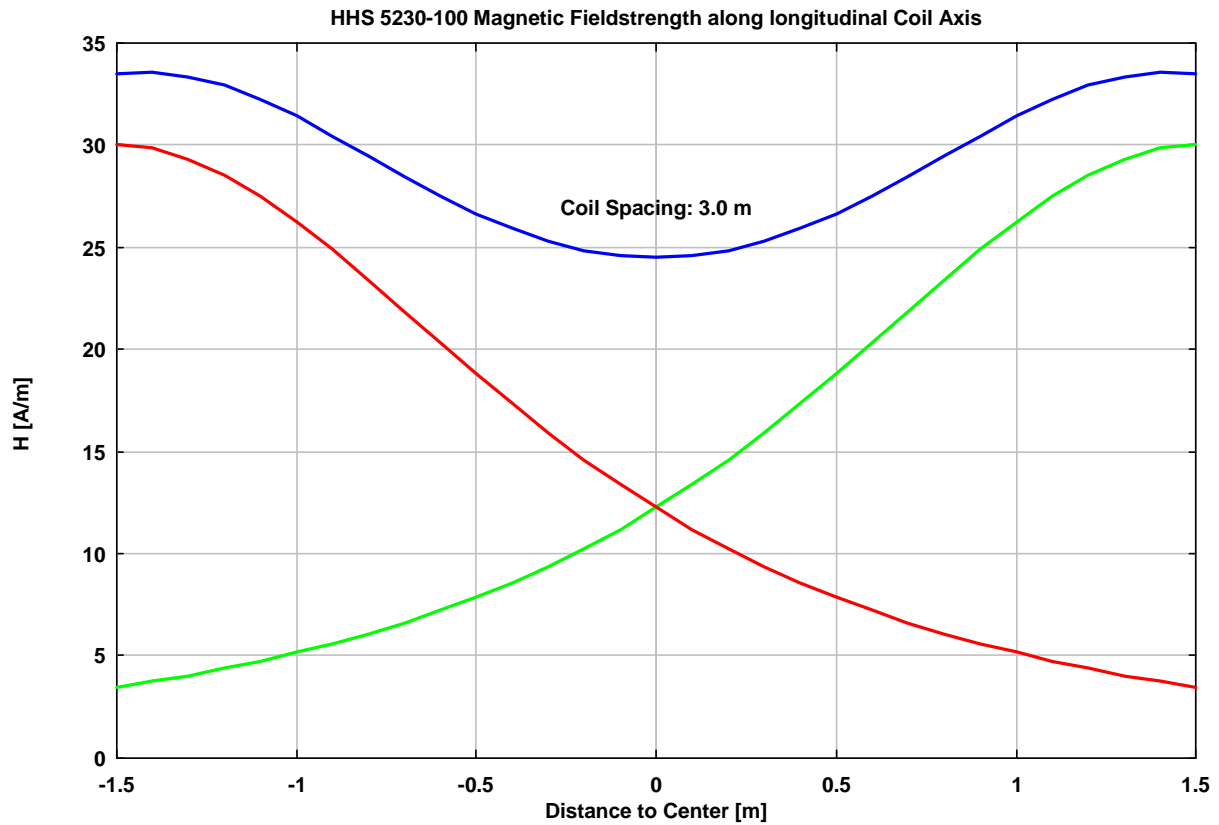
Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dBµA/m	H2 dBµA/m	Htot dBµA/m
0.00	18.7931	18.7931	37.5861	145.48	145.48	151.50
0.05	19.5483	18.0511	37.5994	145.82	145.13	151.50
0.10	20.3139	17.3248	37.6387	146.16	144.77	151.51
0.15	21.0864	16.6163	37.7027	146.48	144.41	151.53
0.20	21.8617	15.9273	37.7890	146.79	144.04	151.55
0.25	22.6354	15.2590	37.8944	147.10	143.67	151.57
0.30	23.4025	14.6124	38.0149	147.39	143.29	151.60
0.35	24.1575	13.9880	38.1455	147.66	142.92	151.63
0.40	24.8945	13.3864	38.2809	147.92	142.53	151.66
0.45	25.6073	12.8077	38.4149	148.17	142.15	151.69
0.50	26.2891	12.2517	38.5409	148.40	141.76	151.72
0.55	26.9333	11.7185	38.6518	148.61	141.38	151.74
0.60	27.5329	11.2077	38.7406	148.80	140.99	151.76
0.65	28.0813	10.7187	38.8001	148.97	140.60	151.78
0.70	28.5720	10.2513	38.8232	149.12	140.22	151.78
0.75	28.9988	9.8046	38.8034	149.25	139.83	151.78
0.80	29.3562	9.3782	38.7344	149.35	139.44	151.76
0.85	29.6394	8.9713	38.6107	149.44	139.06	151.73
0.90	29.8446	8.5833	38.4279	149.50	138.67	151.69
0.95	29.9689	8.2134	38.1823	149.53	138.29	151.64
1.00	30.0105	7.8609	37.8714	149.55	137.91	151.57

Spulenstrom: 1 A, Spulenabstand: 2.0 m
Coil Current: 1 A, Coil Separation: 2.0 m



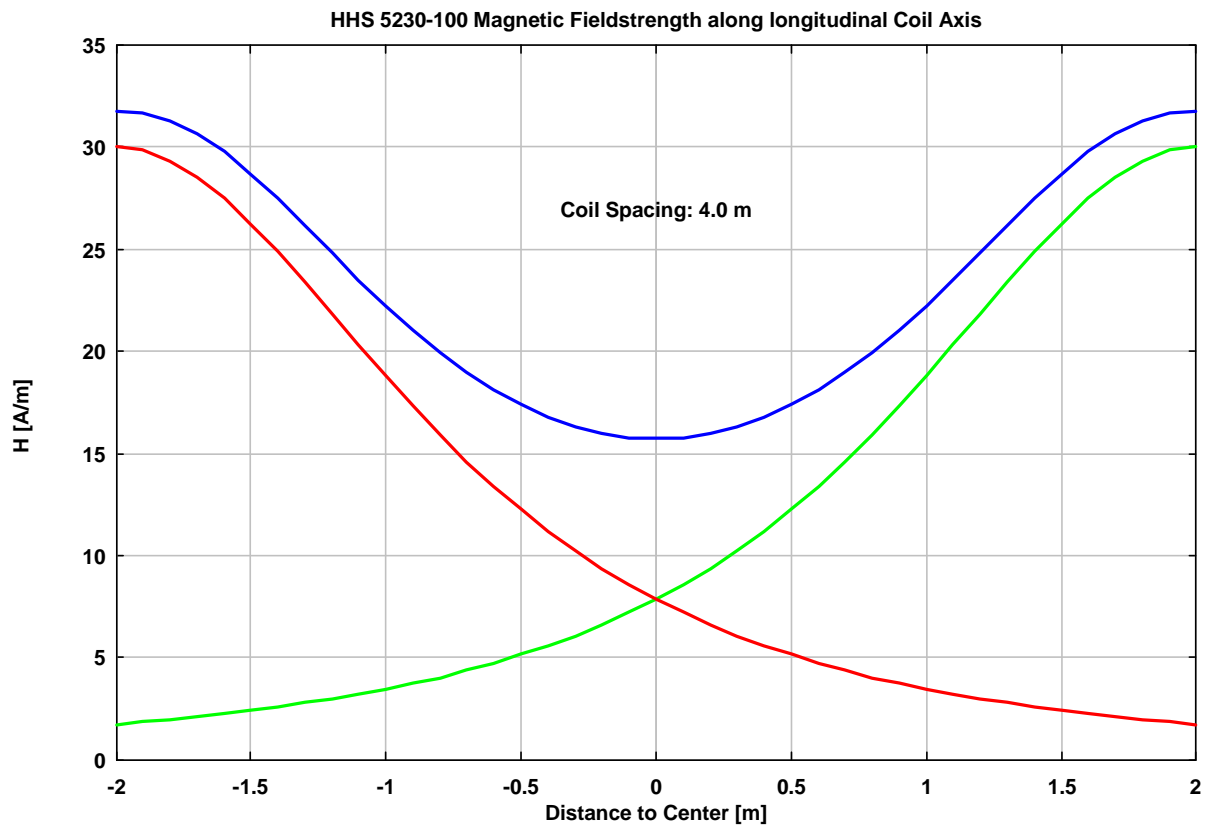
Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse <i>Magnet. Fieldstrength, longitudinal component along rotational axis</i>						
Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dB μ A/m	H2 dB μ A/m	Htot dB μ A/m
0.00	15.2590	15.2590	30.5181	143.67	143.67	149.69
0.05	15.9273	14.6124	30.5397	144.04	143.29	149.70
0.10	16.6163	13.9880	30.6044	144.41	142.92	149.72
0.15	17.3248	13.3864	30.7112	144.77	142.53	149.75
0.20	18.0511	12.8077	30.8587	145.13	142.15	149.79
0.25	18.7931	12.2518	31.0448	145.48	141.76	149.84
0.30	19.5483	11.7185	31.2669	145.82	141.38	149.90
0.35	20.3139	11.2077	31.5216	146.16	140.99	149.97
0.40	21.0863	10.7187	31.8051	146.48	140.60	150.05
0.45	21.8617	10.2513	32.1129	146.79	140.22	150.13
0.50	22.6354	9.8046	32.4400	147.10	139.83	150.22
0.55	23.4025	9.3782	32.7807	147.39	139.44	150.31
0.60	24.1575	8.9713	33.1288	147.66	139.06	150.40
0.65	24.8945	8.5833	33.4778	147.92	138.67	150.50
0.70	25.6073	8.2134	33.8207	148.17	138.29	150.58
0.75	26.2891	7.8609	34.1500	148.40	137.91	150.67
0.80	26.9333	7.5251	34.4584	148.61	137.53	150.75
0.85	27.5329	7.2053	34.7382	148.80	137.15	150.82
0.90	28.0813	6.9007	34.9820	148.97	136.78	150.88
0.95	28.5720	6.6106	35.1826	149.12	136.40	150.93
1.00	28.9988	6.3345	35.3332	149.25	136.03	150.96
1.05	29.3562	6.0716	35.4277	149.35	135.67	150.99
1.10	29.6394	5.8212	35.4606	149.44	135.30	150.99
1.15	29.8446	5.5829	35.4275	149.50	134.94	150.99
1.20	29.9689	5.3559	35.3248	149.53	134.58	150.96
1.25	30.0105	5.1397	35.1503	149.55	134.22	150.92

Spulenstrom: 1 A, Spulenabstand: 2.5 m
Coil Current: 1 A, Coil Separation: 2.5 m



Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse <i>Magnet. Fieldstrength, longitudinal component along rotational axis</i>						
Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dB μ A/m	H2 dB μ A/m	Htot dB μ A/m
0.00	12.2518	12.2517	24.5035	141.76	141.76	147.78
0.10	13.3864	11.2077	24.5941	142.53	140.99	147.82
0.20	14.6124	10.2513	24.8636	143.29	140.22	147.91
0.30	15.9273	9.3782	25.3055	144.04	139.44	148.06
0.40	17.3248	8.5833	25.9081	144.77	138.67	148.27
0.50	18.7931	7.8609	26.6540	145.48	137.91	148.52
0.60	20.3139	7.2053	27.5192	146.16	137.15	148.79
0.70	21.8617	6.6106	28.4723	146.79	136.40	149.09
0.80	23.4025	6.0716	29.4740	147.39	135.67	149.39
0.90	24.8945	5.5829	30.4774	147.92	134.94	149.68
1.00	26.2891	5.1397	31.4288	148.40	134.22	149.95
1.10	27.5329	4.7377	32.2706	148.80	133.51	150.18
1.20	28.5720	4.3728	32.9448	149.12	132.82	150.36
1.30	29.3562	4.0412	33.3974	149.35	132.13	150.47
1.40	29.8446	3.7397	33.5844	149.50	131.46	150.52
1.50	30.0105	3.4653	33.4759	149.55	130.79	150.49

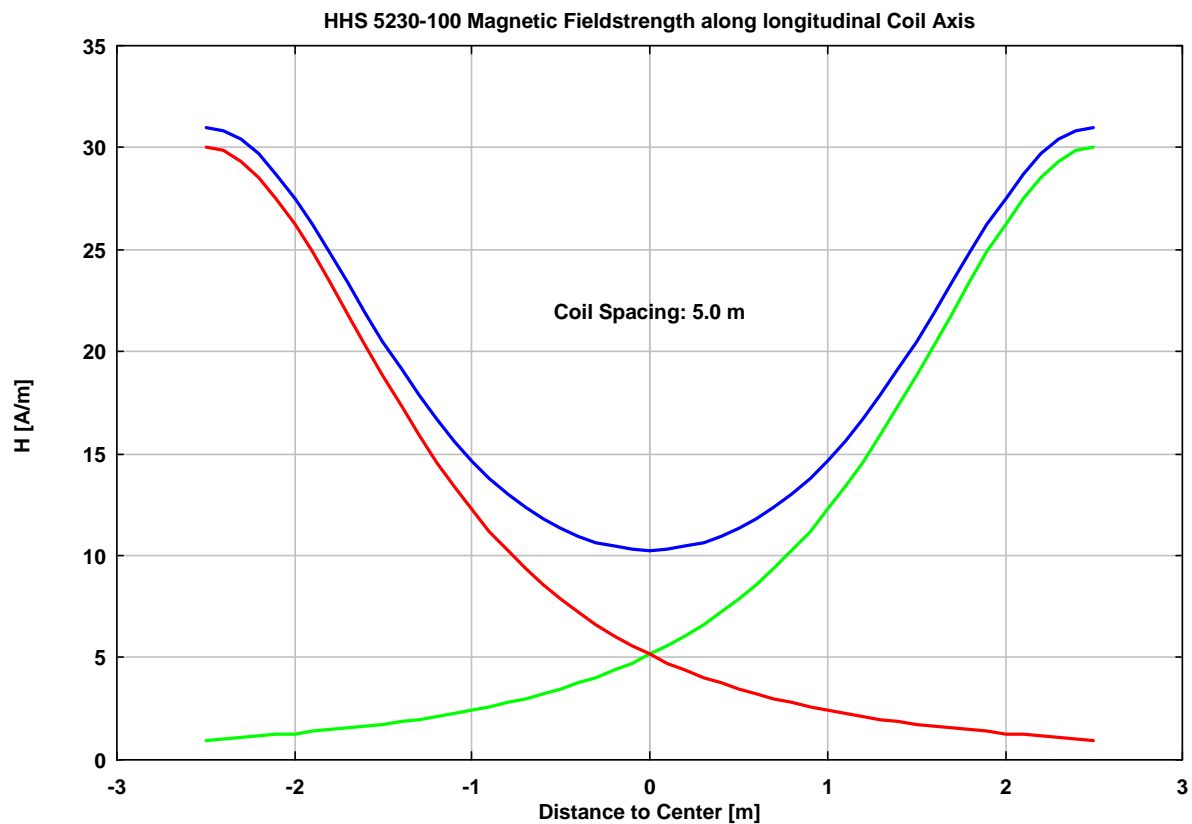
Spulenstrom: 1 A, Spulenabstand: 3.0 m
Coil Current: 1 A, Coil Separation: 3.0 m



Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse
Magnet. Fieldstrength, longitudinal component along rotational axis

Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dBµA/m	H2 dBµA/m	Htot dBµA/m
0.00	7.8609	7.8609	15.7218	137.91	137.91	143.93
0.10	8.5833	7.2053	15.7886	138.67	137.15	143.97
0.20	9.3782	6.6106	15.9888	139.44	136.40	144.08
0.30	10.2513	6.0716	16.3228	140.22	135.67	144.26
0.40	11.2077	5.5829	16.7905	140.99	134.94	144.50
0.50	12.2518	5.1397	17.3915	141.76	134.22	144.81
0.60	13.3864	4.7377	18.1241	142.53	133.51	145.17
0.70	14.6124	4.3728	18.9852	143.29	132.82	145.57
0.80	15.9273	4.0412	19.9686	144.04	132.13	146.01
0.90	17.3248	3.7397	21.0646	144.77	131.46	146.47
1.00	18.7931	3.4653	22.2584	145.48	130.79	146.95
1.10	20.3139	3.2152	23.5292	146.16	130.14	147.43
1.20	21.8617	2.9871	24.8488	146.79	129.51	147.91
1.30	23.4025	2.7787	26.1812	147.39	128.88	148.36
1.40	24.8945	2.5882	27.4827	147.92	128.26	148.78
1.50	26.2891	2.4137	28.7028	148.40	127.65	149.16
1.60	27.5329	2.2538	29.7867	148.80	127.06	149.48
1.70	28.5720	2.1070	30.6790	149.12	126.47	149.74
1.80	29.3562	1.9720	31.3282	149.35	125.90	149.92
1.90	29.8446	1.8479	31.6925	149.50	125.33	150.02
2.00	30.0105	1.7335	31.7440	149.55	124.78	150.03

Spulenstrom: 1 A, Spulenabstand: 4.0 m
Coil Current: 1 A, Coil Separation: 4.0 m



Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse						
<i>Magnet. Fieldstrength, longitudinal component along rotational axis</i>						
Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dBµA/m	H2 dBµA/m	Htot dBµA/m
0.00	5.1397	5.1397	10.2794	134.22	134.22	140.24
0.10	5.5829	4.7377	10.3206	134.94	133.51	140.27
0.20	6.0716	4.3728	10.4443	135.67	132.82	140.38
0.30	6.6106	4.0412	10.6519	136.40	132.13	140.55
0.40	7.2053	3.7397	10.9450	137.15	131.46	140.78
0.50	7.8609	3.4653	11.3262	137.91	130.79	141.08
0.60	8.5833	3.2152	11.7985	138.67	130.14	141.44
0.70	9.3782	2.9871	12.3653	139.44	129.51	141.84
0.80	10.2513	2.7787	13.0300	140.22	128.88	142.30
0.90	11.2077	2.5882	13.7959	140.99	128.26	142.79
1.00	12.2517	2.4137	14.6655	141.76	127.65	143.33
1.10	13.3864	2.2538	15.6402	142.53	127.06	143.88
1.20	14.6124	2.1070	16.7193	143.29	126.47	144.46
1.30	15.9273	1.9720	17.8994	144.04	125.90	145.06
1.40	17.3248	1.8479	19.1727	144.77	125.33	145.65
1.50	18.7931	1.7335	20.5266	145.48	124.78	146.25
1.60	20.3139	1.6280	21.9419	146.16	124.23	146.83
1.70	21.8617	1.5305	23.3922	146.79	123.70	147.38
1.80	23.4025	1.4404	24.8429	147.39	123.17	147.90

Längskomponente der magnetischen Feldstärke entlang der Spulenlängsachse <i>Magnet. Fieldstrength, longitudinal component along rotational axis</i>						
Distance to Center	H1 A/m	H2 A/m	Htot A/m	H1 dB μ A/m	H2 dB μ A/m	Htot dB μ A/m
1.90	24.8945	1.3570	26.2515	147.92	122.65	148.38
2.00	26.2891	1.2797	27.5688	148.40	122.14	148.81
2.10	27.5329	1.2079	28.7408	148.80	121.64	149.17
2.20	28.5720	1.1413	29.7132	149.12	121.15	149.46
2.30	29.3561	1.0793	30.4354	149.35	120.66	149.67
2.40	29.8446	1.0216	30.8662	149.50	120.19	149.79
2.50	30.0105	0.9678	30.9783	149.55	119.72	149.82
Spulenstrom: 1 A, Spulenabstand: 5.0 m <i>Coil Current: 1 A, Coil Separation: 5.0 m</i>						