KLIPPEL ANALYZER SYSTEM

Report

Object: **M10 D4**

Comment:

Operation: **LPM T/S M10 D4 parallel**

Comment: Measures linear parameters (Thiele & Small parameter) of Subwoofers.
Driver connected to SPEAKER 2 channel.
(SP2 = current sensitive channel at DA, High Current Sensitivity is default for SP2 at KA3)

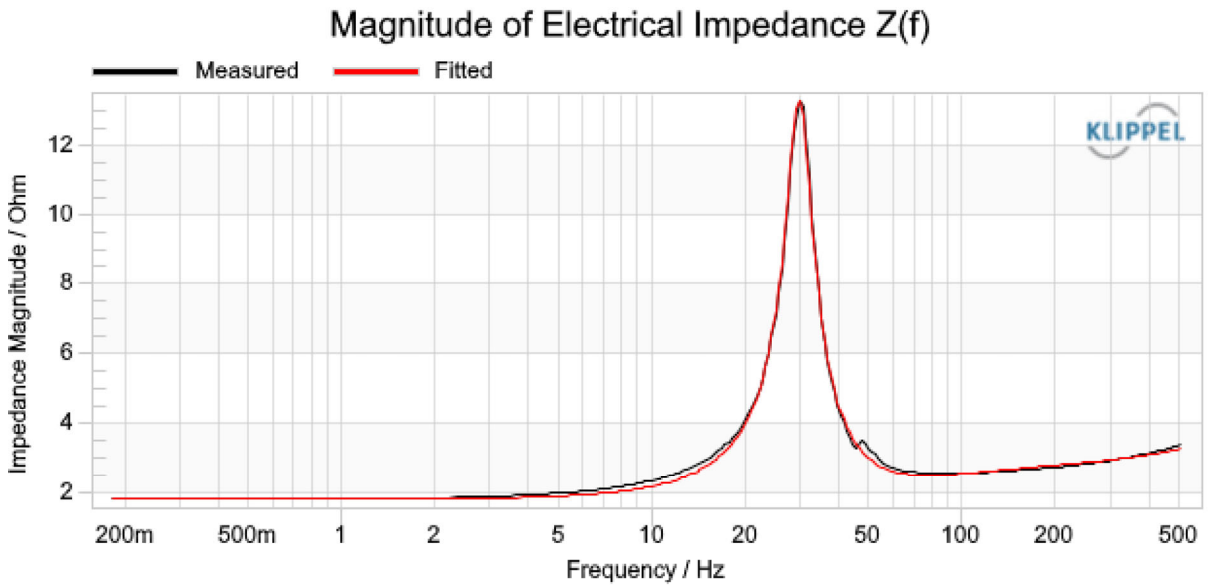
Stimulus recommendation:
- for DUTs with resonance frequency fs <= 32 Hz
- LPM reference frequency should be <= 1/2 * fs
- A resolution of 1/30 octave is recommended for T/S parameter determination (1/31 oct. doubles the measurement time!)
- Fmax should be between 20 * fs and 100 * fs
- Adjust voltage and averaging if a low SNR warning get displayed!

Database: **M10 D4**

Table Linear Parameters

Name	Value	Unit	Comment
Electrical Parameters			
Re	1.80	Ohm	electrical voice coil resistance at DC
Le	0.527	mH	frequency independent part of voice coil inductance
L2	2.295	mH	para-inductance of voice coil
R2	1.02	Ohm	electrical resistance due to eddy current losses
Cmes	2211.15	µF	electrical capacitance representing moving mass
Lces	12.74	mH	electrical inductance representing driver compliance
Res	11.33	Ohm	resistance due to mechanical losses
fs	30.0	Hz	driver resonance frequency
Mechanical Parameters			
(using laser)			
Mms	217.707	g	mechanical mass of driver diaphragm assembly including air load and voice coil
Mmd (Sd)	210.423	g	mechanical mass of voice coil and diaphragm without air load
Rms	8.690	kg/s	mechanical resistance of total-driver losses
Cms	0.129	mm/N	mechanical compliance of driver suspension
Kms	7.73	N/mm	mechanical stiffness of driver suspension

Bl	9.923	N/A	force factor (Bl product)
Lambda s	0.000		suspension creep factor
Loss factors			
Qtp	0.695		total Q-factor considering all losses
Qms	4.720		mechanical Q-factor of driver in free air considering Rms only
Qes	0.750		electrical Q-factor of driver in free air considering Re only
Qts	0.647		total Q-factor considering Re and Rms only
Other Parameters			
Vas	21.9660	l	equivalent air volume of suspension
n0	0.076	%	reference efficiency (2 pi-radiation using Re)
Lm	80.82	dB	characteristic sound pressure level (at 1 m for 1 W @ Re)
Lnom	87.30	dB	nominal sensitivity (SPL at 1 m for 1 W @ Zn)
rmse Z	4.35	%	root-mean-square fitting error of driver impedance Z(f)
rmse Hx	4.19	%	root-mean-square fitting error of transfer function Hx(f)
Series resistor	0.00	Ohm	resistance of series resistor
Sd	346.36	cm2	diaphragm area



Report Generated: 01/04/24 10:52:27 by user: Administrator

For instructions about customizing this template or inserting your company logo refer to *dB-Lab Manual* section *Report Generator.*

Disclaimer: *Measurement results (data, parameters, curves, PASS/FAIL decisions) depend on the measurement methods and the setup made by the user. The measurement methods are described in the KLIPPEL product specifications, papers and user manuals. KLIPPEL is not liable for any damage caused by misinterpretation of results.*

Report created with dB-Lab, KLIPPEL GmbH, Germany - www.klippel.de

KLIPPEL ANALYZER SYSTEM

Report

Object: **M10 D4**

Comment:

Operation: **LPM T/S M10 D4 series**

Comment: Measures linear parameters (Thiele & Small parameter) of Subwoofers.
Driver connected to SPEAKER 2 channel.
(SP2 = current sensitive channel at DA, High Current Sensitivity is default for SP2 at KA3)

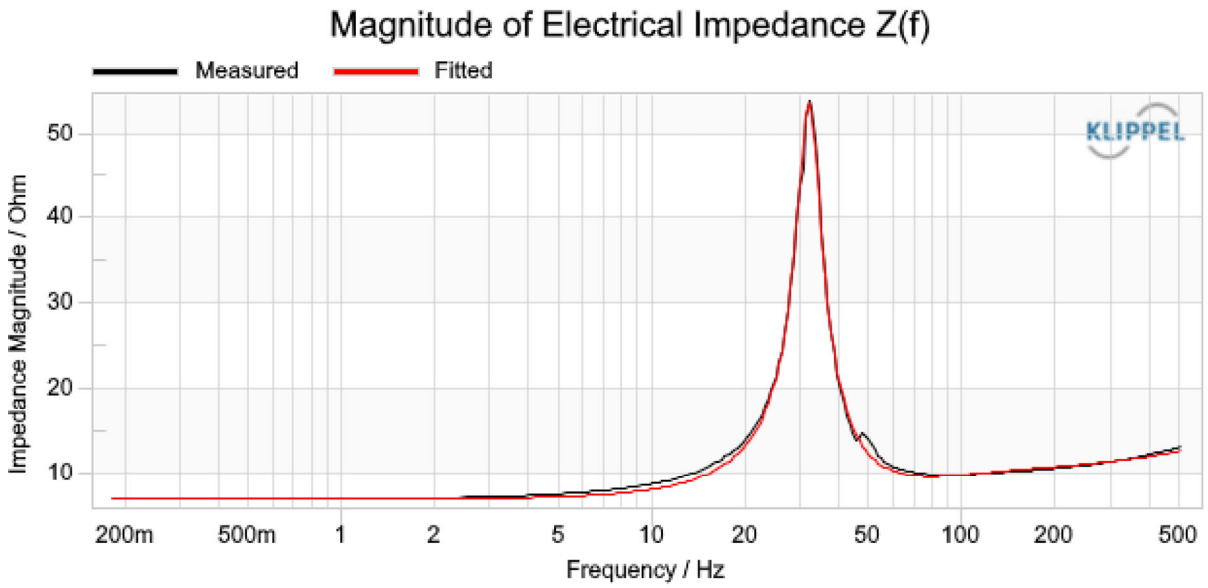
Stimulus recommendation:
- for DUTs with resonance frequency fs <= 32 Hz
- LPM reference frequency should be <= 1/2 * fs
- A resolution of 1/30 octave is recommended for T/S parameter determination (1/31 oct. doubles the measurement time!)
- Fmax should be between 20 * fs and 100 * fs
- Adjust voltage and averaging if a low SNR warning get displayed!

Database: **M10 D4**

Table Linear Parameters

Name	Value	Unit	Comment
Electrical Parameters			
Re	6.99	Ohm	electrical voice coil resistance at DC
Le	2.081	mH	frequency independent part of voice coil inductance
L2	8.914	mH	para-inductance of voice coil
R2	3.96	Ohm	electrical resistance due to eddy current losses
Cmes	560.89	µF	electrical capacitance representing moving mass
Lces	43.40	mH	electrical inductance representing driver compliance
Res	45.74	Ohm	resistance due to mechanical losses
fs	32.3	Hz	driver resonance frequency
Mechanical Parameters			
(using laser)			
Mms	231.815	g	mechanical mass of driver diaphragm assembly including air load and voice coil
Mmd (Sd)	224.531	g	mechanical mass of voice coil and diaphragm without air load
Rms	9.037	kg/s	mechanical resistance of total-driver losses
Cms	0.105	mm/N	mechanical compliance of driver suspension
Kms	9.52	N/mm	mechanical stiffness of driver suspension

Bl	20.330	N/A	force factor (Bl product)
Lambda s	0.005		suspension creep factor
Loss factors			
Qtp	0.747		total Q-factor considering all losses
Qms	5.200		mechanical Q-factor of driver in free air considering Rms only
Qes	0.795		electrical Q-factor of driver in free air considering Re only
Qts	0.690		total Q-factor considering Re and Rms only
Other Parameters			
Vas	17.8260	l	equivalent air volume of suspension
n0	0.072	%	reference efficiency (2 pi-radiation using Re)
Lm	80.61	dB	characteristic sound pressure level (at 1 m for 1 W @ Re)
Lnom	81.20	dB	nominal sensitivity (SPL at 1 m for 1 W @ Zn)
rmse Z	4.90	%	root-mean-square fitting error of driver impedance Z(f)
rmse Hx	4.06	%	root-mean-square fitting error of transfer function Hx(f)
Series resistor	0.00	Ohm	resistance of series resistor
Sd	346.36	cm2	diaphragm area



Report Generated: 01/04/24 10:53:08 by user: Administrator

For instructions about customizing this template or inserting your company logo refer to *dB-Lab Manual* section *Report Generator.*

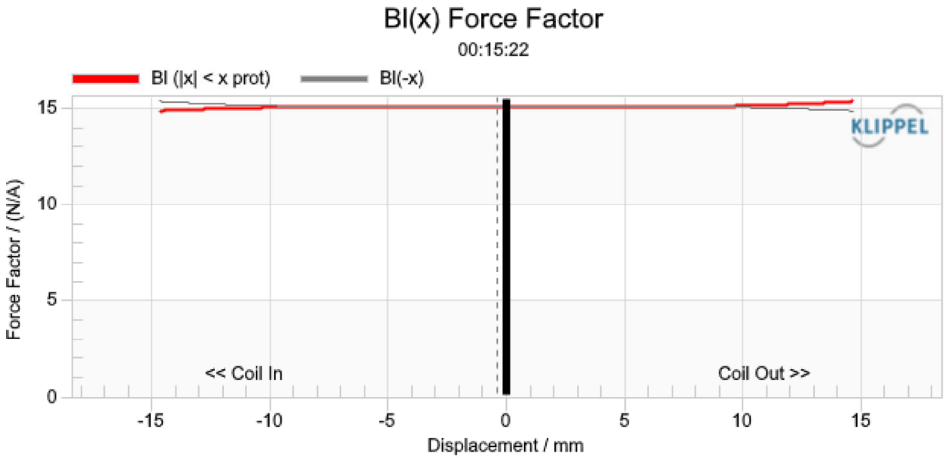
Disclaimer: *Measurement results (data, parameters, curves, PASS/FAIL decisions) depend on the measurement methods and the setup made by the user. The measurement methods are described in the KLIPPEL product specifications, papers and user manuals. KLIPPEL is not liable for any damage caused by misinterpretation of results.*

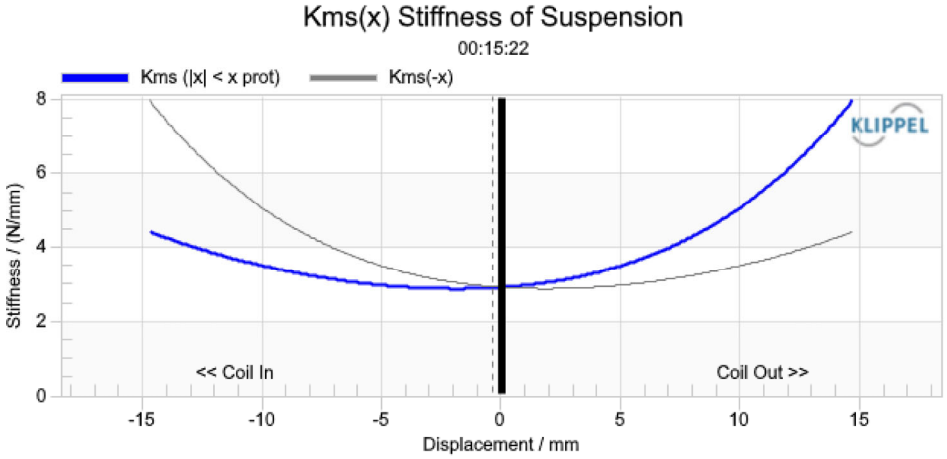
Report created with dB-Lab, KLIPPEL GmbH, Germany - www.klippel.de

KLIPPEL ANALYZER SYSTEM

Report

Object:	**M10 D4**
Comment:	
Operation:	**LSI3 M10 D4**
Comment:	
Database:	**M10 D4**





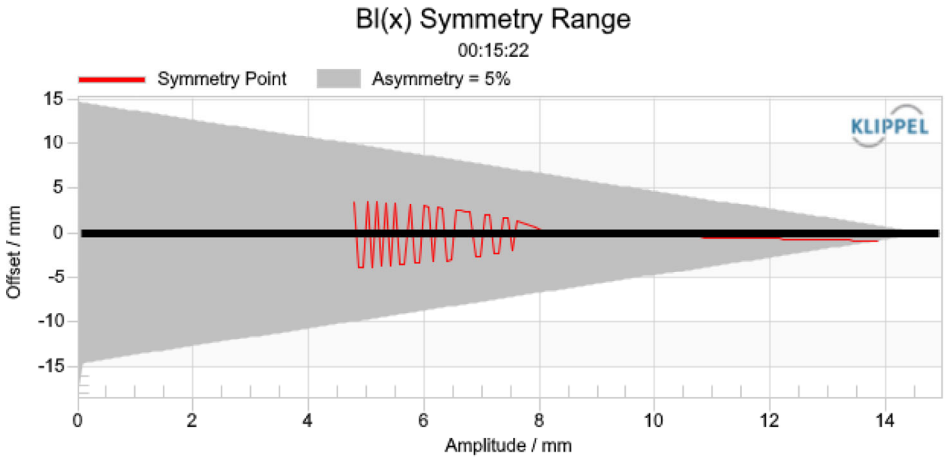


Table Parameters at x=0

Symbol	Large + Warm	Large + Cold	Small Signal	Unit	Comment
ΔT_v	35.47	0.00	0.00	K	Increase of voice coil temperature
x_{prot}	14.71	14.71	0.16	mm	Maximum voice coil excursion allowed by protection system
$R_e(T_v)$	8.07	7.11	7.11	Ω	Voice coil resistance considering the voice coil temperature ΔT_v
$L_e(x=0)$	1.12	1.12	0.87	mH	Voice coil inductance at the coil's rest position
$L_2(x=0)$	5.75	5.75	4.59	mH	Electrical inductance model parameter
$R_2(x=0)$	7.53	7.53	7.00	Ω	Electrical resistance due to magnetic losses
$f_s(x=0)$	23.77	23.77	30.45	Hz	Driver resonance frequency
$Q_{ts}(x=0, T_v)$	0.58	0.52	0.70		Total Q-factor considering $R_e(T_v)$ and R_{ms} at f_s
$Q_{es}(x=0, T_v)$	0.69	0.61	0.76		Electrical Q-factor at f_s, considering $R_e(T_v)$ only
$Q_{ms}(x=0)$	3.55	3.55	9.40		Mechanical Q-factor at f_s, considering R_{ms} only
$Bl(x=0)$	15.090	15.090	-	N/A	(IMPORTED) Force factor at the rest position (Bl product)
M_{ms}	130.601	130.601	-	g	Moving mass including air load
$K_{ms}(x=0)$	2.91	2.91	4.65	N/mm	Mechanical stiffness of the driver suspension at f_s
$C_{ms}(x=0)$	0.34	0.34	0.22	mm/N	Mechanical compliance of the driver suspension at f_s
$R_{ms}(x=0)$	5.487	5.487	2.583	kg/s	Mechanical resistance of total driver losses at f_s
$C_{mes}(x=0)$	573.55	573.55	557.63	µF	Electrical capacitance representing moving mass
$L_{ces}(x=0)$	78.18	78.18	48.99	mH	Electrical inductance representing driver compliance at f_s
$R_{es}(x=0)$	41.50	41.50	88.14	Ω	Electrical resistance representing non-electrical losses at f_s
S_d	346.36	346.36	346.36	cm^2	(IMPORTED) effective sound radiation area. Used to display V_{as}, η_0 and L_m
V_{as}	57.8521	57.8521	36.2467	l	Equivalent air volume of suspension
η_0	0.1081	0.1227	0.1297	%	Reference efficiency (2π-sr radiation using $R_e(T_v)$)
L_m	82.36	82.91	83.15	dB	Characteristic sound pressure level

Table Nonlinear Parameters

Symbol	Value	Unit	Comment
Displacement Limits			
x_{Bl} @ Bl_{min}=70%	>14.71	mm	Displacement limit due to force factor variation
x_C @ C_{min}=75%	6.69	mm	Displacement limit due to compliance variation
x_L @ Z_{max}=10%	>14.71	mm	Displacement limit due to inductance variation
x_d @ d_2=10%	38.11	mm	Displacement limit due Doppler IM distortion
Asymmetry (IEC 62458)			
x_{sym}	-	mm	Symmetry point of $Bl(x)$ at x_{prot}
a_{bl}	-3.25	%	$Bl(x)$ asymmetry $A_{bl}(x_{prot})$
a_{kms}	-56.42	%	Stiffness asymmetry $A_{kms}(x_{prot})$
Power Series			
Bl0 = Bl(X=0)	15.0900000	N/A	Constant part in force factor
Bl1	-0.0072585	N/Amm	1st order coefficient in force factor expansion
Bl2	-0.0000207	N/Amm^2	2nd order coefficient in force factor expansion
Bl3	0.0001115	N/Amm^3	3rd order coefficient in force factor expansion
Bl4	0.0000008	N/Amm^4	4th order coefficient in force factor expansion
K0 = K_{ms}(X=0)	2.9124545	N/mm	Constant part in stiffness
K1	0.0430880	N/mm^2	1st order coefficient in stiffness expansion
K2	0.0124681	N/mm^3	2nd order coefficient in stiffness expansion
K3	0.0003572	N/mm^4	3rd order coefficient in stiffness expansion

K4	0.0000126	N/mm^5	4th order coefficient in stiffness expansion
C0 = C_{ms}(X=0)	0.3433530	mm/N	Constant part in compliance
C1	-0.0052766	1/N	1st order coefficient in compliance expansion
C2	-0.0012596	1/Nmm	2nd order coefficient in compliance expansion
C3	0.0000086	$1/Nmm^2$	3rd order coefficient in compliance expansion
C4	0.0000023	$1/Nmm^3$	4th order coefficient in compliance expansion
L0 = L_e(X=0)	1.1178990	mH	Constant part in inductance
Lx1	-0.0022083	mH/mm	1st order coefficient in inductance expansion
Lx2	-0.0008239	mH/mm^2	2nd order coefficient in inductance expansion
Lx3	0.0000026	mH/mm^3	3rd order coefficient in inductance expansion
Lx4	0.0000005	mH/mm^4	4th order coefficient in inductance expansion
f1	0.0041501	1/A	1st coefficient of L(I) Inductance over current (flux modulation)
f2	-0.0001047	$1/A^2$	2nd coefficient of L(I) Inductance over current (flux modulation)

Report Generated: 01/04/24 10:57:38 by user: Administrator

For instructions about customizing this template or inserting your company logo refer to *dB-Lab Manual* section *Report Generator*.

Disclaimer: *Measurement results (data, parameters, curves, PASS/FAIL decisions) depend on the measurement methods and the setup made by the user. The measurement methods are described in the KLIPPEL product specifications, papers and user manuals. KLIPPEL is not liable for any damage caused by misinterpretation of results.*

Report created with dB-Lab, KLIPPEL GmbH, Germany - www.klippel.de