

## Large Signal Identification (LSI) Report

Test Performed by Erin Hardison on behalf of

**DIYmobileaudio.com**

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**Date:** 10/3/2011

**Driver Name:** Scanspeak 18WU/4741t00

**Link to Driver:**

**<http://www.madisoundspeakerstore.com/approx-6-7-woofers/scanspeak-illuminator-18wu/4747t-00-7-aluminum-cone-woofer-4-ohm/>**

**Woofer Tester 2 [WT2.CFG] - [WT2 [Sine,LoZP->Q/Fs,83pt]]**

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Woofer Tests		Mon Oct 03 17:12:28 2011 [-]	
X Q,Fs test	[ - ] Vas	Q,Fs complete	Vas complete
- Vas test		Re = 3.2401 ohms	Vas = 29.5769 L ( 1.0445 ft^3 )
- Box test		Fs = 40.2090 Hz	Diam= 137.1600 mm ( 5.4000 in )
- Arb1 sweep		Qes = 0.5031	Sd = 14775.5910 mm^2 ( 22.9022 in^2 )
- Arb2 sweep		Qms = 7.1050	BL = 5.1700 N/A
RUN Sweep		Qts = 0.4699	Cms = 953.6699 um/N
ZP Calibrate		Zmax= 48.9959 ohms	Kms = 1048.5808 N/m
Frequency Hz		Le = 0.2073 mH	Mms = 16.4284 g
< 435.180 >			Sens= 87.5700 dB@1W/1m
Drive Level			Eff = 0.3591 %
< 100.000% >			Rms = 0.5842 ohms
UNMUTED			Sine Impedance::Norm

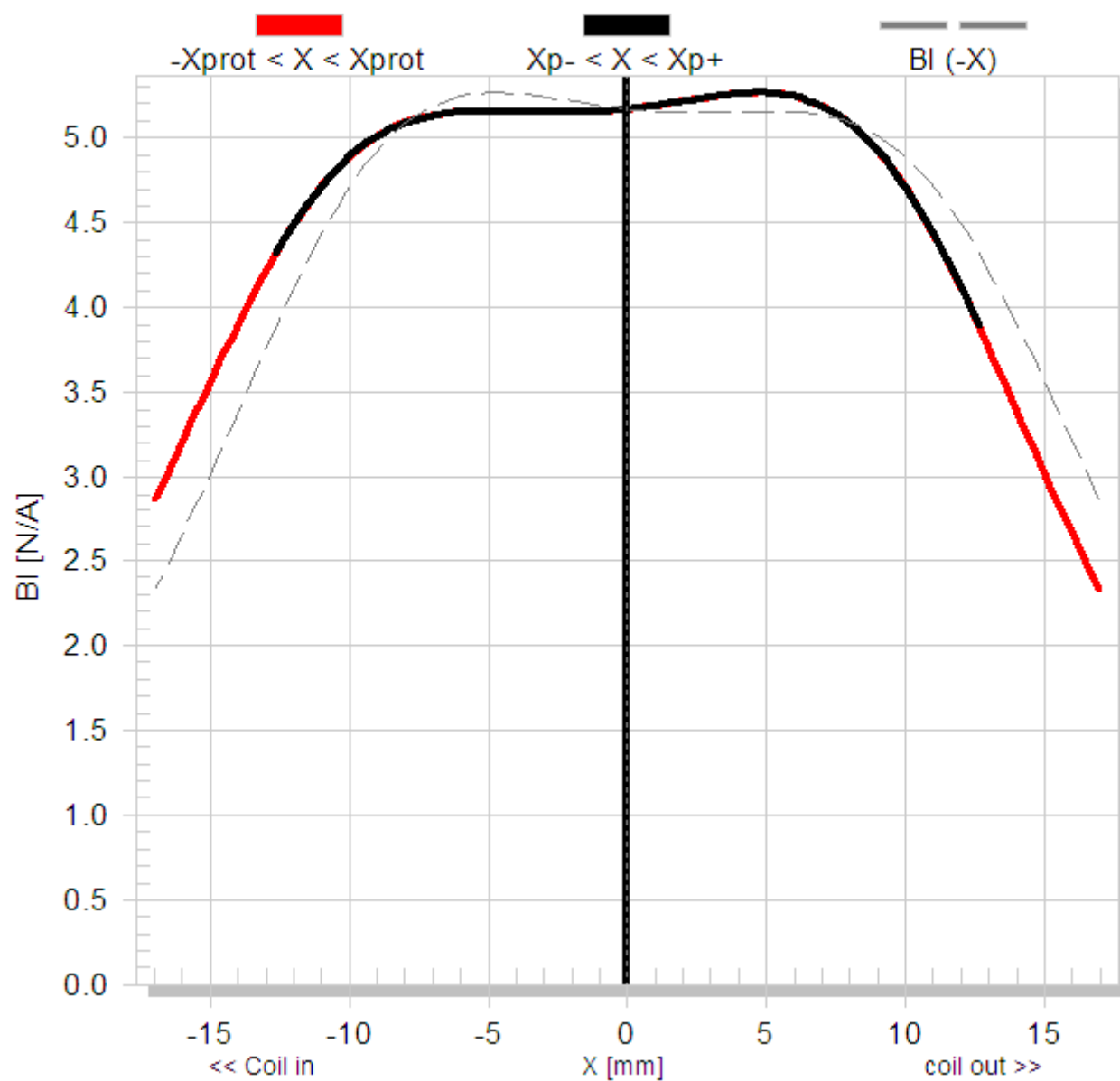
Meter Readings	
Z = 4.897 Ω	
R = 4.842 Ω	
I = 726.902 mA	
Ph= +8.54 deg	
L = 265.845 uH	
17.492 mV	
3.614 mA	
63.223 uVar	
62.522 uW	
Sweep Pt= 100	
SwpRatio=1.300	

The graph displays two curves against a logarithmic frequency axis ranging from 5 Hz to 20 kHz. The left y-axis represents Phase in degrees, ranging from -100.0 to 100.0. The right y-axis represents Impedance in ohms, ranging from 0.000 to 50.000. A blue curve represents the phase response, which starts near 0 degrees at low frequencies, rises to a peak of approximately 60 degrees at the resonance frequency (around 40 Hz), and then falls sharply to about -60 degrees before rising again towards 0 degrees at higher frequencies. A red curve represents the impedance response, which remains relatively flat until the resonance frequency, where it exhibits a sharp dip, reaching its minimum value of approximately 4.8 ohms. After the resonance, the impedance gradually increases back towards its nominal value.

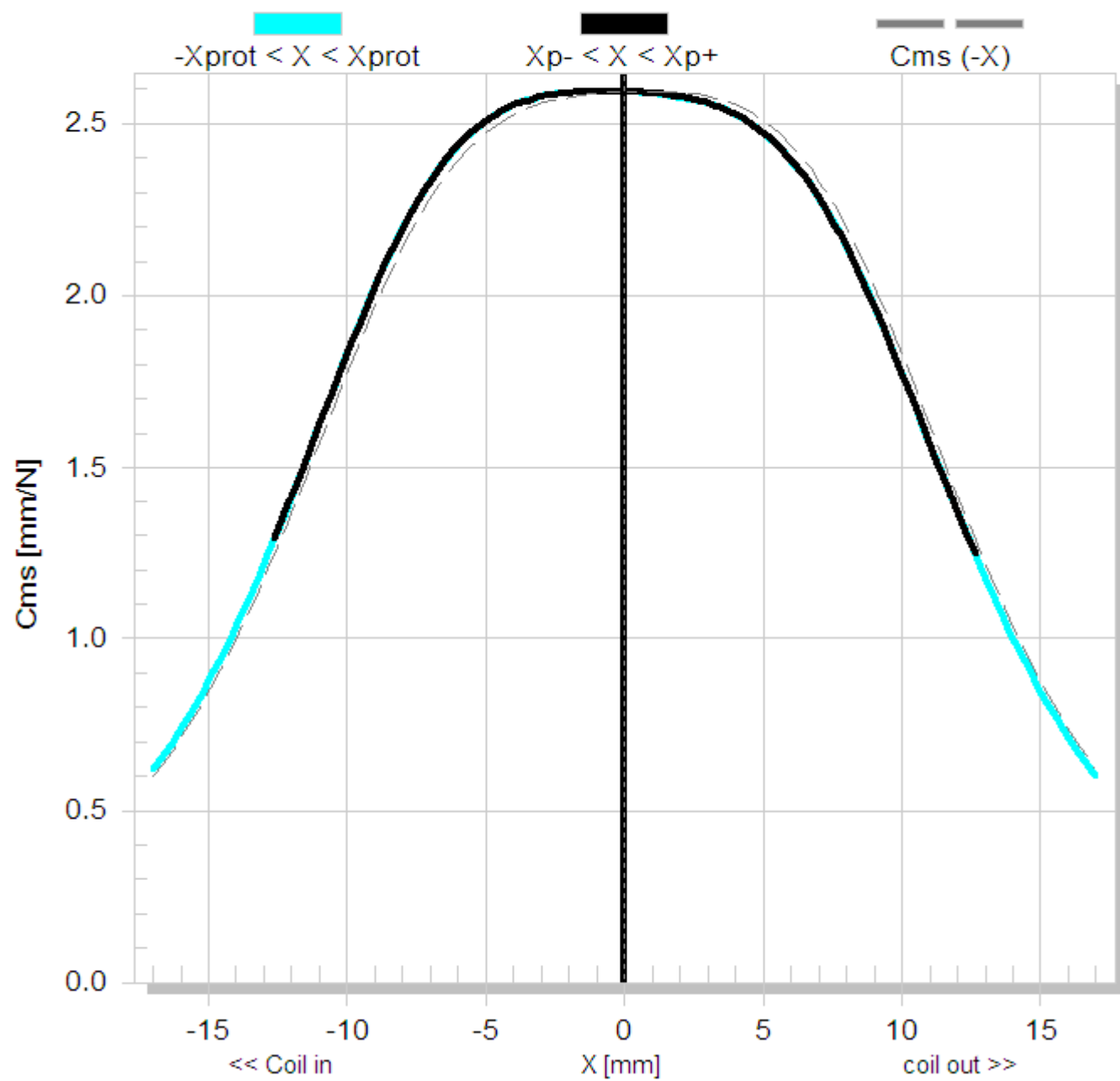
# Force factor BI (X)

(00:15:17)



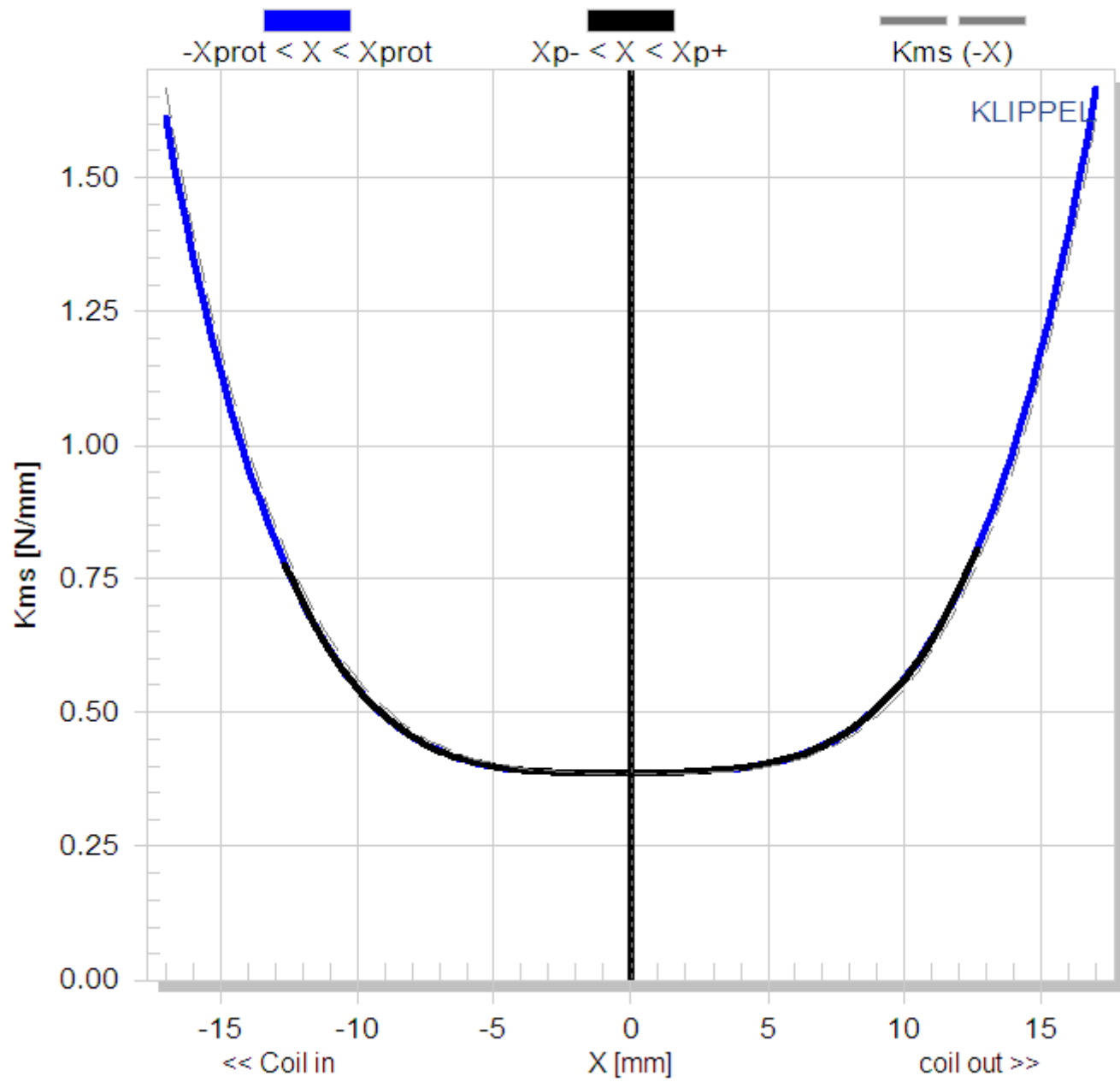
# Mechanical compliance Cms (X)

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# Stiffness of suspension $K_{ms}(X)$

(00:15:17)

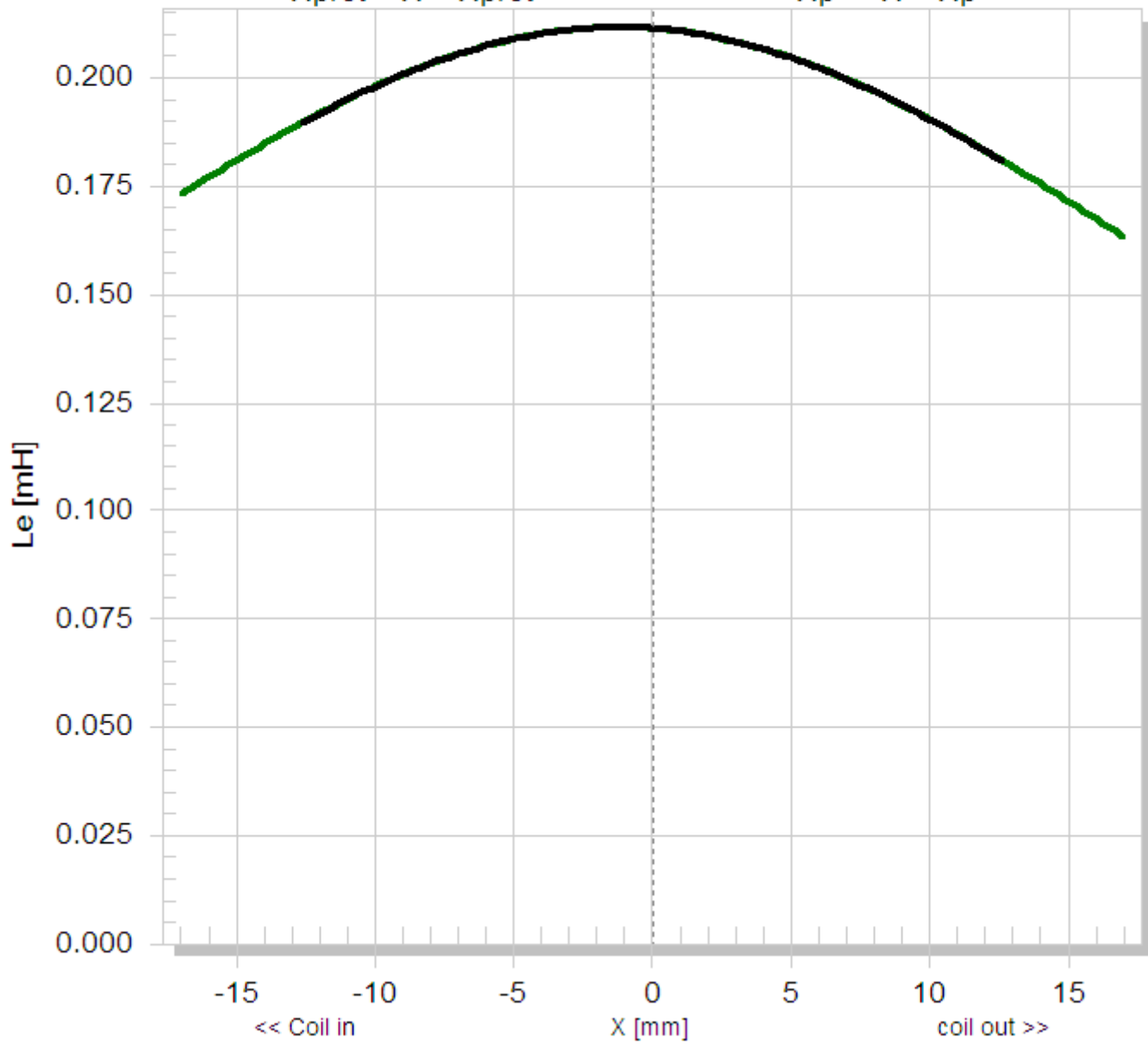


# Electrical inductance $L(X, I=0)$

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$-X_{prot} < X < X_{prot}$

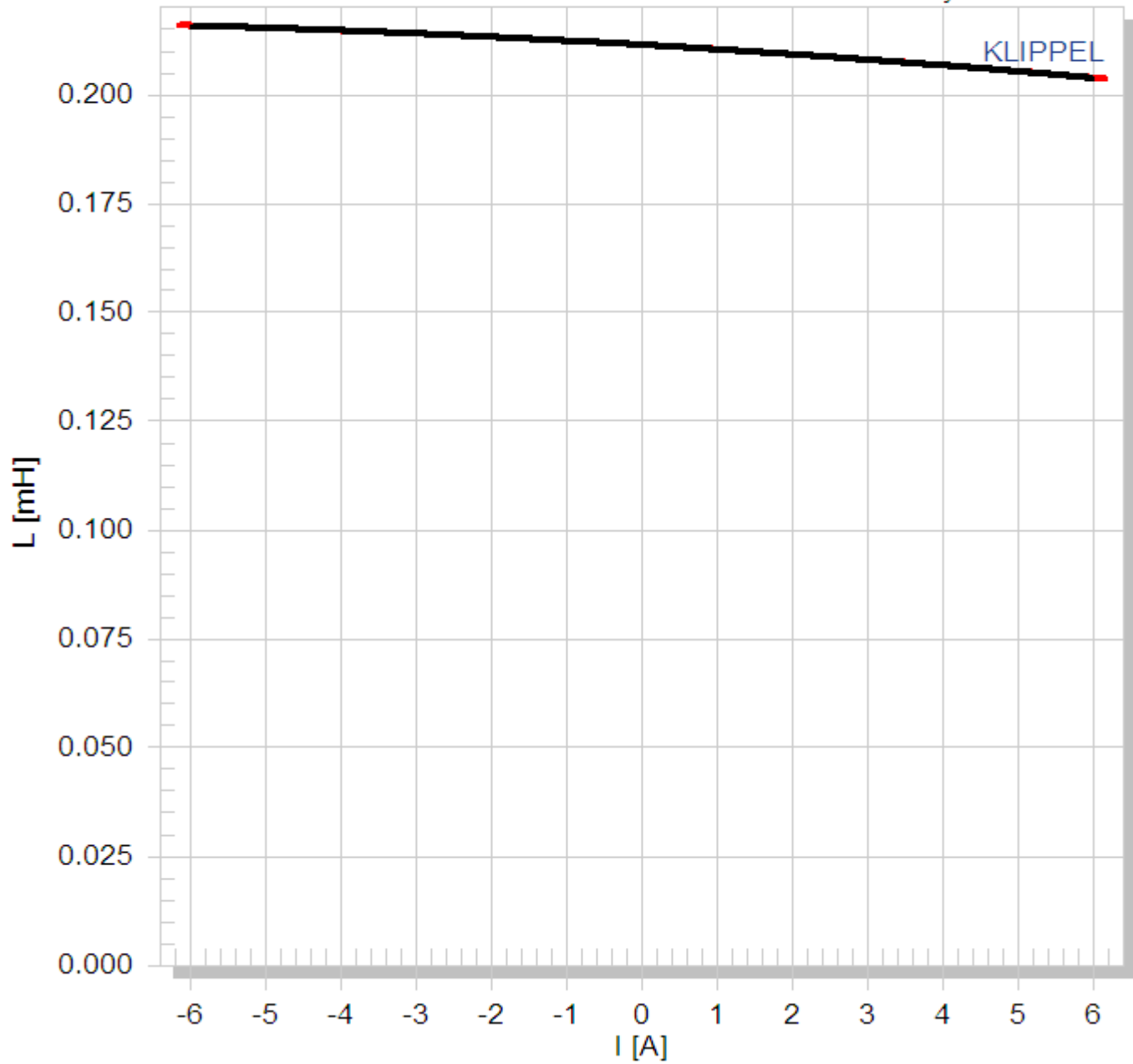
$X_{p-} < X < X_{p+}$



# Inductance over current $L(X=0, I)$


$-I_{\max} < I < I_{\max}$


momentary

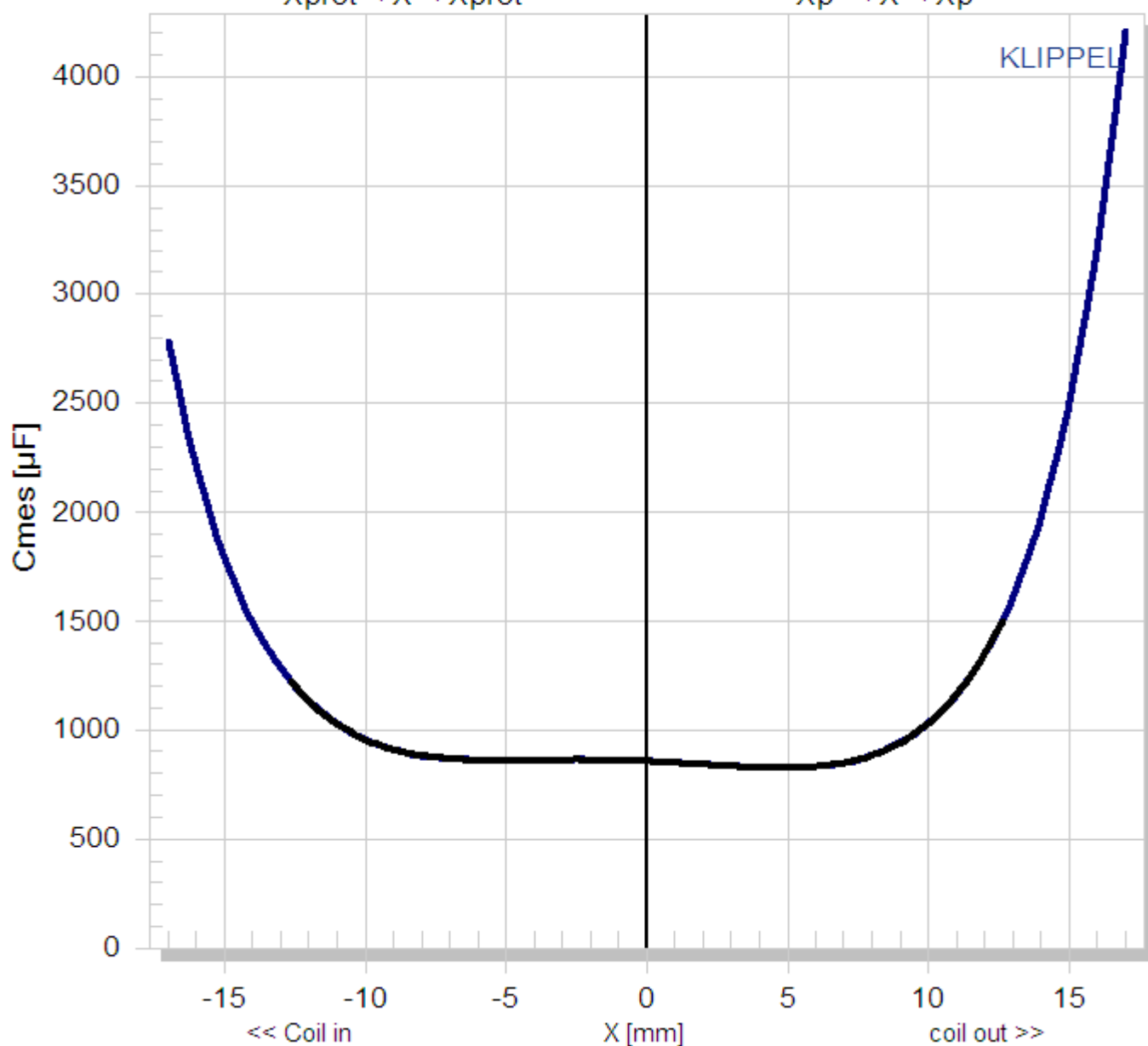


# Capacitance Cmes (X) corresponds to driver mass

(00:15:17)


  $-X_{prot} < X < X_{prot}$


  $X_{p-} < X < X_{p+}$

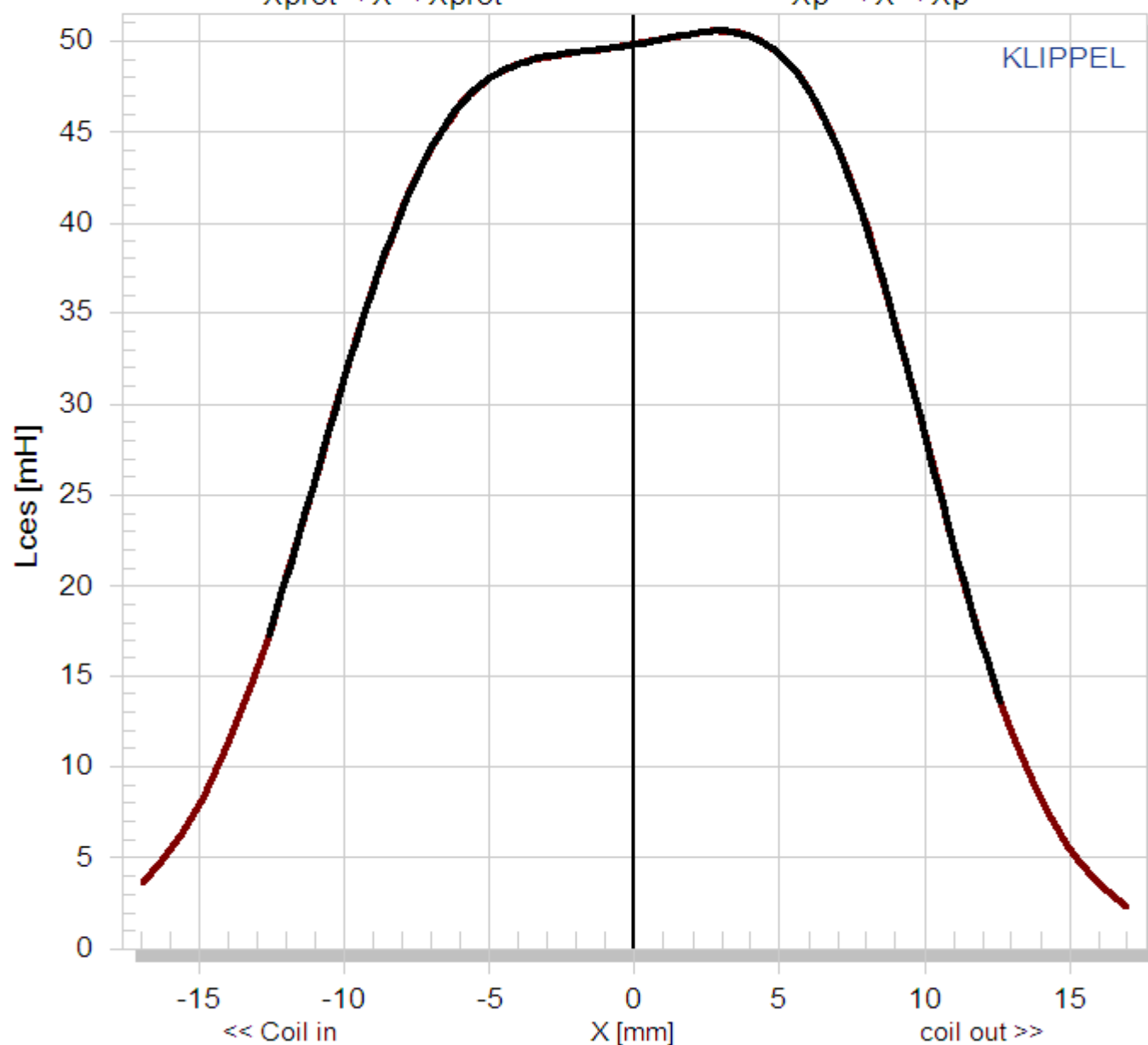





# Inductance $L_{ces}$ (X) corresponds to suspension compliance (00:15:17)


  
 $-X_{prot} < X < X_{prot}$

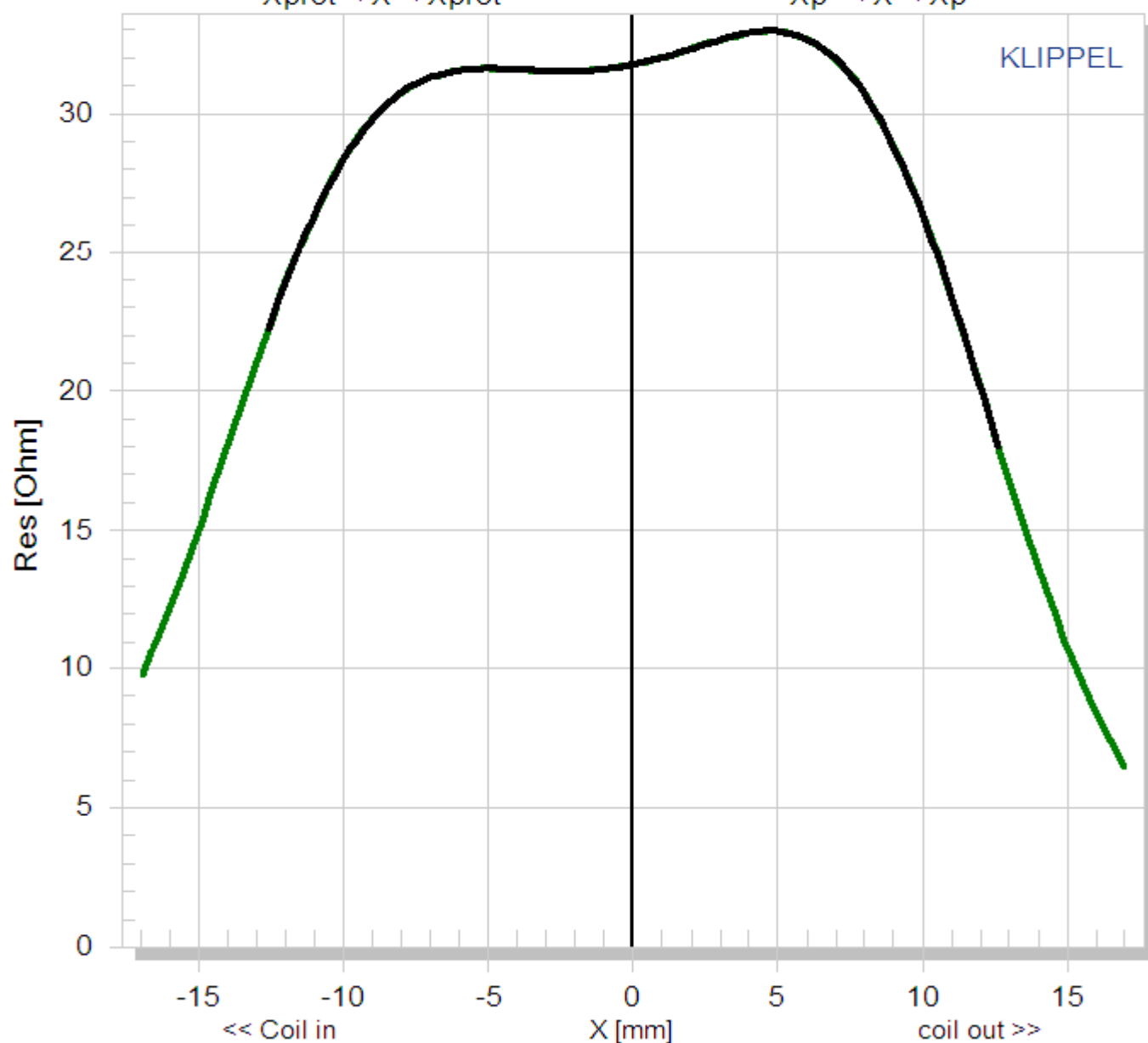
  
 $X_{p-} < X < X_{p+}$



# Resistance Res (X) corresponds to suspension resistance (00:15:17)

  $-X_{prot} < X < X_{prot}$

  $X_{p-} < X < X_{p+}$

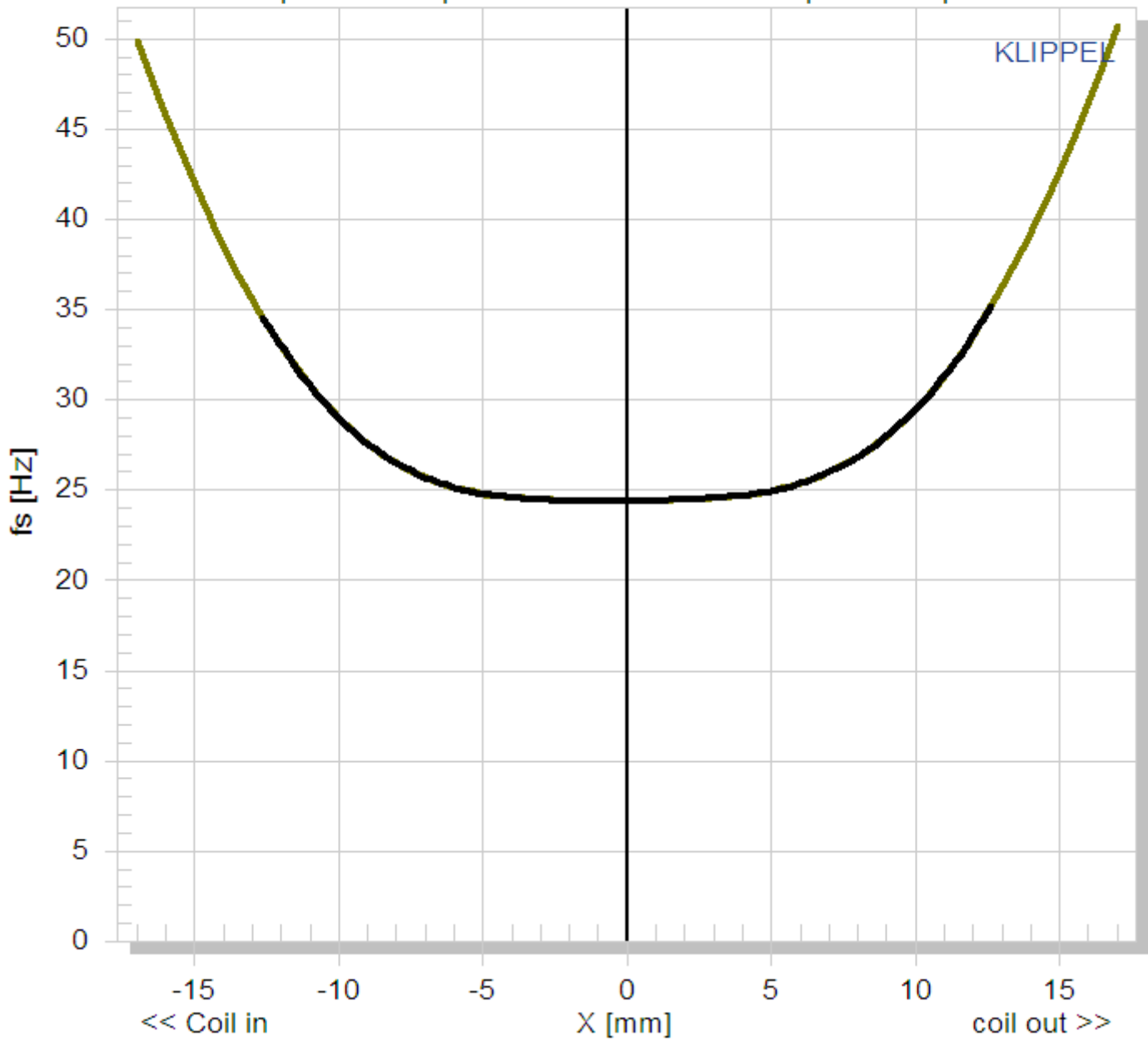


# Resonance frequency $f_s$ (X)

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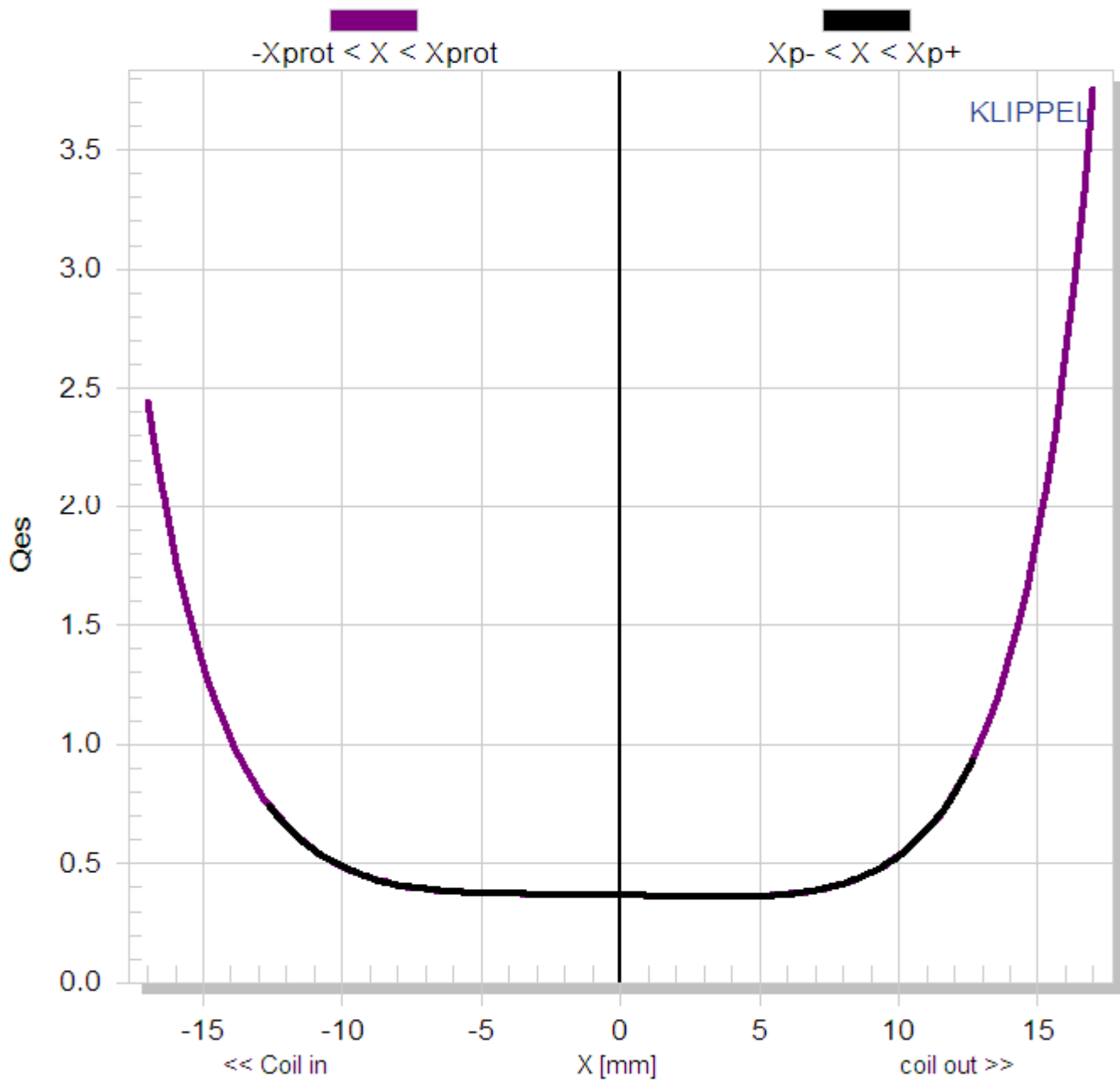
$-X_{prot} < X < X_{prot}$

$X_{p-} < X < X_{p+}$



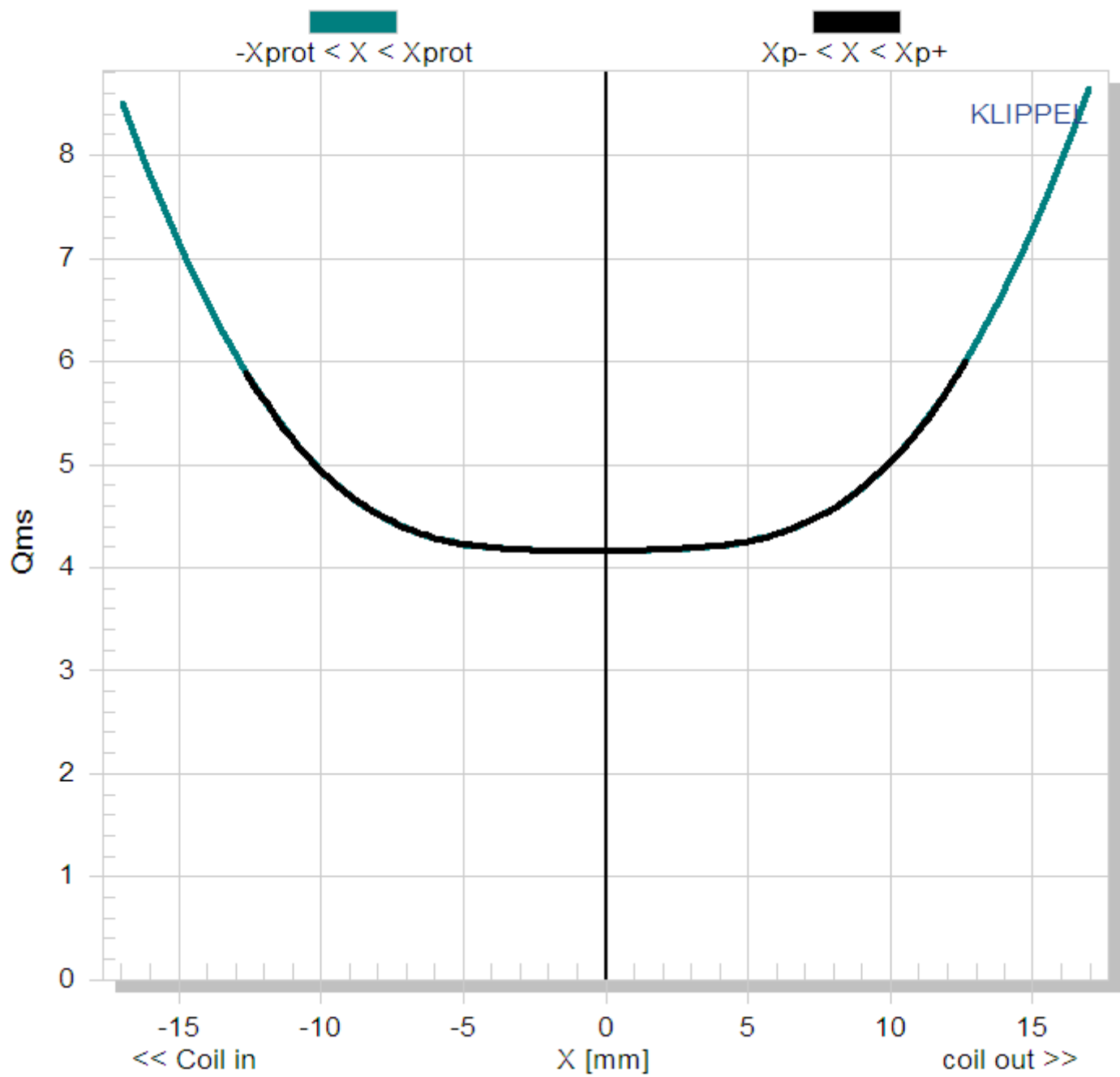
# Electrical loss factor Qes (X)

(00:15:17)



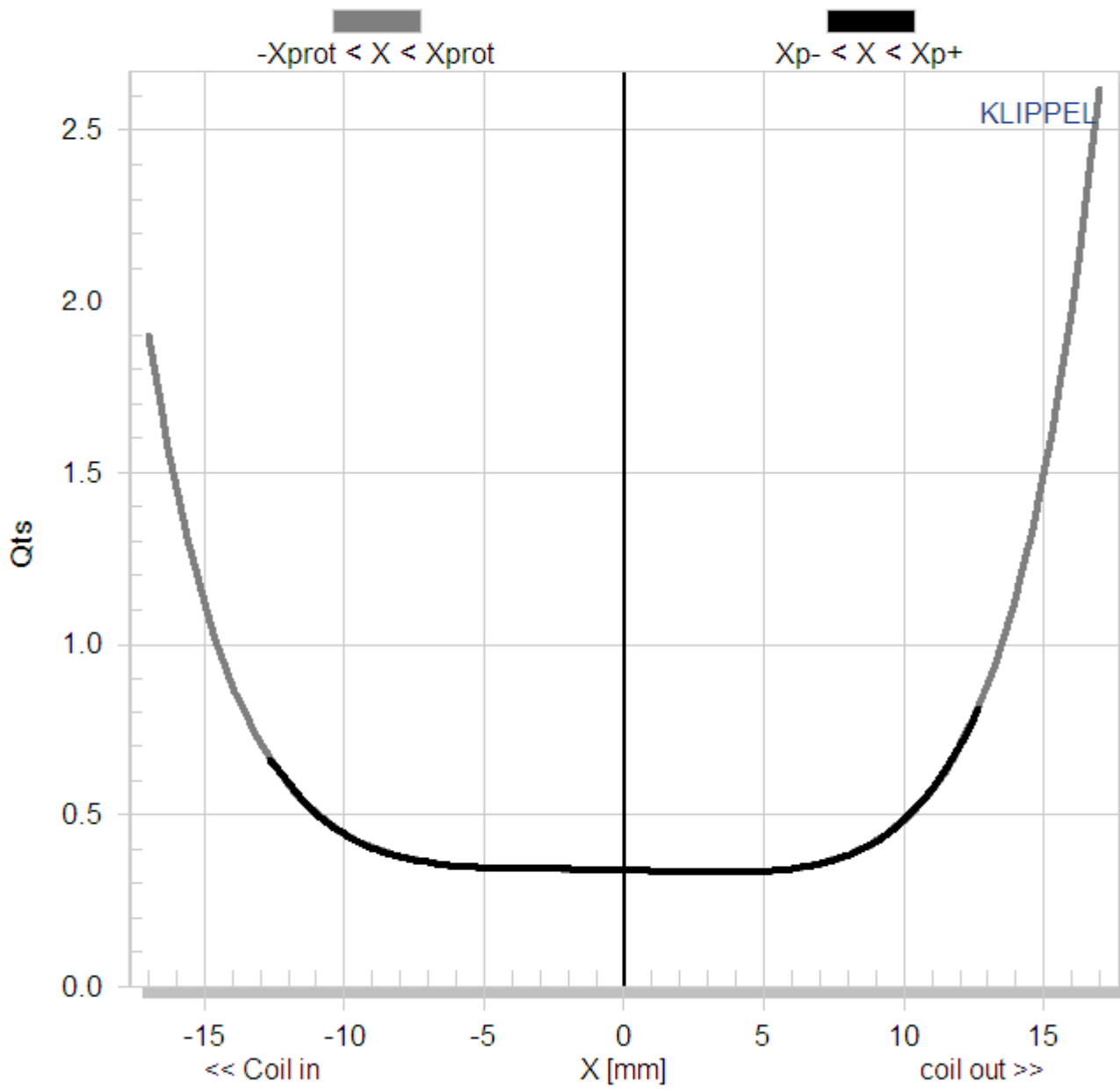
# Mechanical loss factor $Q_{ms}(X)$

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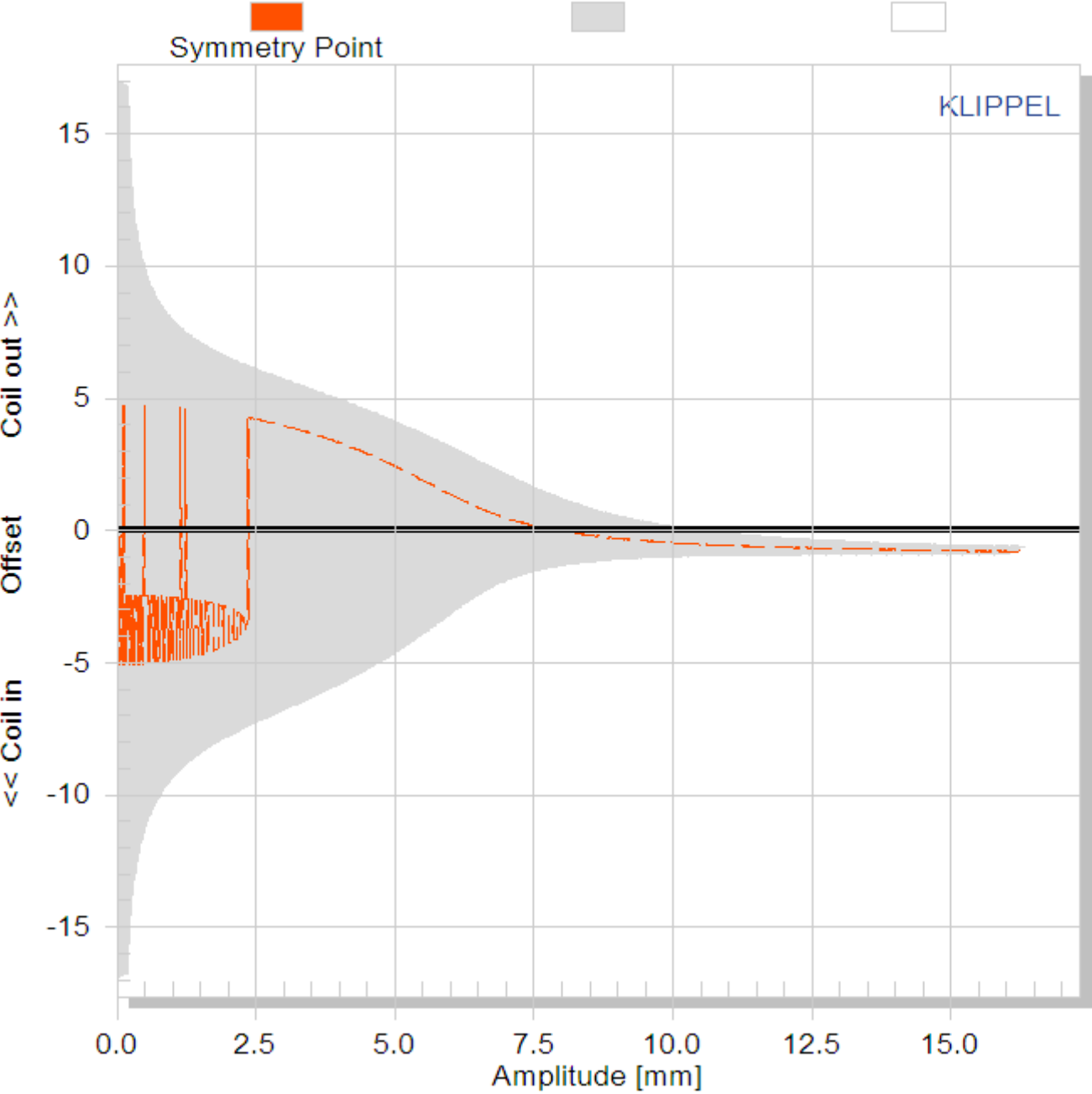


# Total loss factor Qts (X)

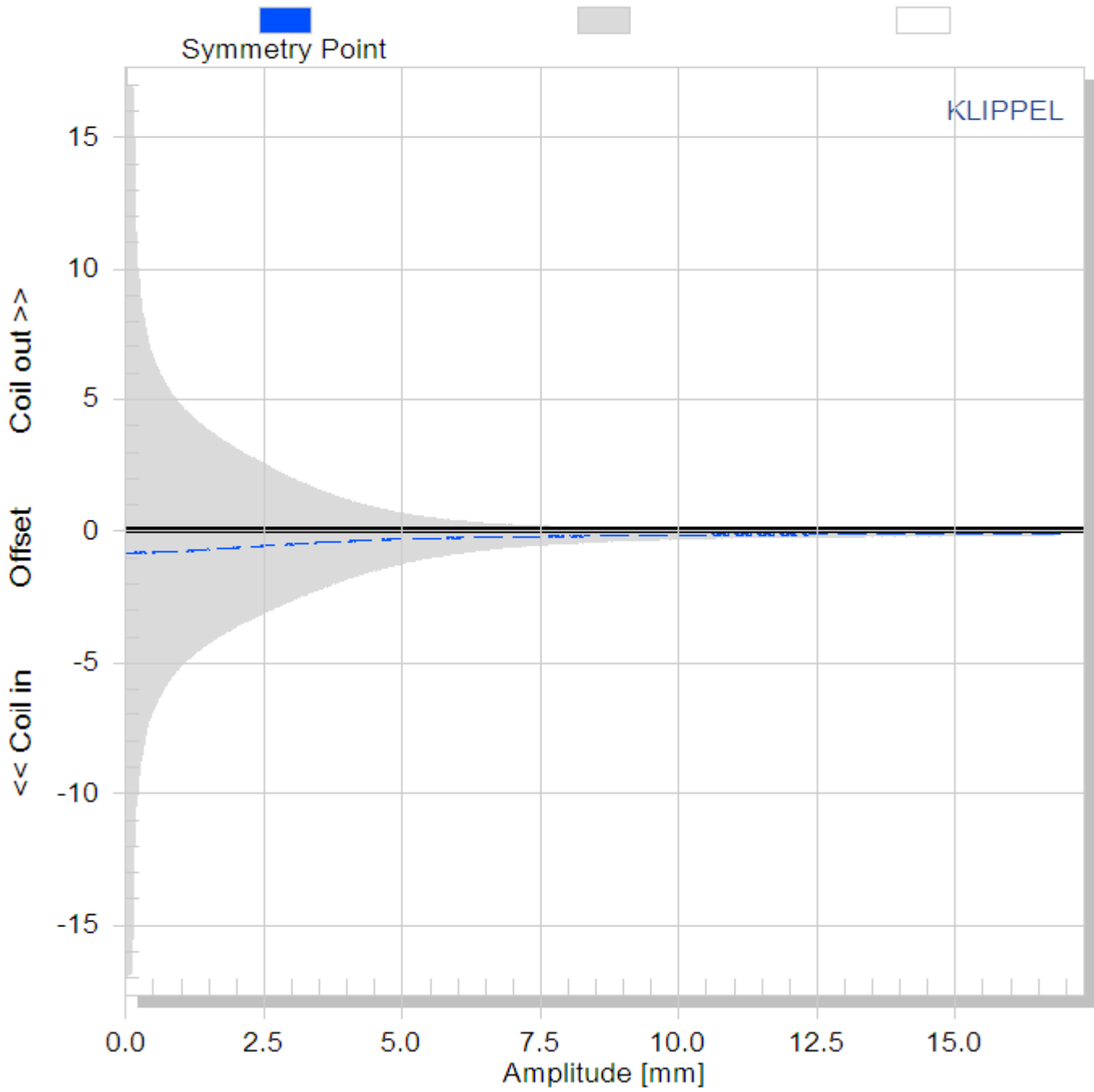
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# BI Symmetry Range



# Kms Symmetry Range





Symbol	Number	Unit	Comment
Displacement Limits			thresholds can be changed in Processing property page
X Bl @ Bl min=82%	11.6	mm	Displacement limit due to force factor variation
X C @ C min=75%	9.1	mm	Displacement limit due to compliance variation
X L @ Z max=10 %	>12.6	mm	Displacement limit due to inductance variation
X d @ d2=10%	37.1	mm	Displacement limit due to IM distortion (Doppler)
alpha			Heating of voice coil by eddy currents
alphaOrg			Heating of voice coil by eddy currents (without limits)
Rtv		K/W	thermal resistance coil ==> pole tips
rv		Ws/Km	air convection cooling depending on velocity
Rtm		K/W	thermal resistance magnet ==> environment
tau m		min	thermal time constant of magnet
Ctm		Ws/K	thermal capacity of the magnet
tau v		s	thermal time constant of voice coil
Ctv		Ws/K	thermal capacity of the voice coil
delta Tw		K	Temperature increase in Warm Resistance Mode
delta Tc		K	Temperature increase in Convection Mode
delta Te		K	Temperature increase in Eddy Mode
Pcoil(warm)		W	Pcoil in warm mode
Pcoil(conv)		W	Pcoil in convection mode
Ptv(mag.beg)		W	power heating the coil at beginning of magnet mode
Ptv(mag.mid)		W	power heating the coil sampled in the middle of magnet mode
Ptv(mag.end)		W	power heating the coil at end of magnet mode
Ptm(mag.beg)		W	power heating the magnet at beginning of magnet mode
Ptm(mag.mid)		W	power heating the magnet sampled in the middle of magnet mode
Ptm(mag.end)		W	power heating the magnet at end of magnet mode
f1	-0.004720	1/A	coefficient (1) of Inductance over current (flux modulation)
f2	-0.000209	1/A^2	coefficient (2) of Inductance over current (flux modulation)
Bl0 = Bl (X=0)	5.2462	N/A	constant part in force factor
Bl1	0.0087515	N/Amm	1st order coefficient in force factor expansion
Bl2	-0.0019191	N/Amm^2	2nd order coefficient in force factor expansion
Bl3	-0.00014296	N/Amm^3	3rd order coefficient in force factor expansion
Bl4	-2.9500e-005	N/Amm^4	4th order coefficient in force factor expansion
Bl5		N/Amm^5	5th order coefficient in force factor expansion

Bl6		N/Amm <sup>6</sup>	6th order coefficient in force factor expansion
Bl7		N/Amm <sup>7</sup>	7th order coefficient in force factor expansion
Bl8		N/Amm <sup>8</sup>	8th order coefficient in force factor expansion
L0 = Le (X=0)	0.21131	mH	constant part in inductance
L1	-0.00044137	mH/mm	1st order coefficient in inductance expansion
L2	-0.00018310	mH/mm <sup>2</sup>	2nd order coefficient in inductance expansion
L3	5.7892e-007	mH/mm <sup>3</sup>	3rd order coefficient in inductance expansion
L4	1.2227e-007	mH/mm <sup>4</sup>	4th order coefficient in inductance expansion
L5		mH/mm <sup>5</sup>	5th order coefficient in inductance expansion
L6		mH/mm <sup>6</sup>	6th order coefficient in inductance expansion
L7		mH/mm <sup>7</sup>	7th order coefficient in inductance expansion
L8		mH/mm <sup>8</sup>	8th order coefficient in inductance expansion
C0 = Cms (X=0)	2.6788	mm/N	constant part in compliance
C1	-0.0016081	1/N	1st order coefficient in compliance expansion
C2	-0.0095589	1/Nmm	2nd order coefficient in compliance expansion
C3	-6.8874e-006	1/Nmm <sup>2</sup>	3rd order coefficient in compliance expansion
C4	6.9259e-006	1/Nmm <sup>3</sup>	4th order coefficient in compliance expansion
C5		1/Nmm <sup>4</sup>	5th order coefficient in compliance expansion
C6		1/Nmm <sup>5</sup>	6th order coefficient in compliance expansion
C7		1/Nmm <sup>6</sup>	7th order coefficient in compliance expansion
C8		1/Nmm <sup>7</sup>	8th order coefficient in compliance expansion
K0 = Kms (X=0)		N/mm	constant part in stiffness
K1	0.00047781	N/mm <sup>2</sup>	1st order coefficient in stiffness expansion
K2	0.00027811	N/mm <sup>3</sup>	2nd order coefficient in stiffness expansion
K3	4.0079e-006	N/mm <sup>4</sup>	3rd order coefficient in stiffness expansion
K4	1.4089e-005	N/mm <sup>5</sup>	4th order coefficient in stiffness expansion
Xpse	17.0	mm	-Xpse < X < Xpse, range where power series is fitted

Symbol	Large + Warm	Large + Cold	Small Signal	Unit	Comment
Note:					for accurate small signal parameters, use LPM module
Delta Tv = Tv-Ta	54	0	0	K	increase of voice coil temperature during the measurement
Xprot	17.0	17.0	1.8	mm	maximal voice coil excursion (limited by protection system)

Re (Tv)	3.90	3.24	3.24	Ohm	(imported) voice coil resistance considering increase of voice coil temperature Tv
Le (X=0)	0.21	0.21	0.21	mH	voice coil inductance at the rest position of the voice coil
L2 (X=0)	1.41	1.41	1.37	mH	para-inductance at the rest position due to the effect of eddy current
R2 (X=0)	0.45	0.45	0.44	Ohm	resistance at the rest position due to eddy currents
Cmes (X=0)	854	854	726	μF	electrical capacitance representing moving mass
Lces (X=0)	49.84	49.84	31.91	mH	electrical inductance at the rest position representing driver compliance
Res (X=0)	31.77	31.77	37.25	Ohm	resistance at the rest position due to mechanical losses
Qms (X=0, Tv)	4.16	4.16	5.62		mechanical Q-factor considering Rms only
Qes (Tv)	0.37	0.31	0.41		electrical Q-factor considering Re (Tv) only
Qts (X=0, Tv)	0.34	0.28	0.39		total Q-factor considering Re (Tv) and Rms only
fs	24.4	24.4	33.1	Hz	driver resonance frequency
Mms	16.420	16.420	16.420	g	(imported) mechanical mass of driver diaphragm assembly including voice-coil and air load
Rms (X=0)	0.605	0.605	0.607	kg/s	mechanical resistance of total-driver losses
Cms (X=0)	2.59	2.59	1.41	mm/N	mechanical compliance of driver suspension at the rest position
Bl (X=0)	5.17	5.17	5.17	N/A	(imported) force factor at the rest position (Bl product)
Sd	n/a				IMPORT Sd at Driver page to display Vas, N0, and Lm

Symbol	Value	Unit	Comment
Date	2011-10-03		
Time	19:10:25		
Serial number	302		
Mode	Nonlinear Mode 5(7)		
Record	353/353		
Laser	signal reliable		
t	00:15:17	h:min:s	measurement time
Time remaining	00:04:43	h:min:s	recalculated at thermal mode(a)

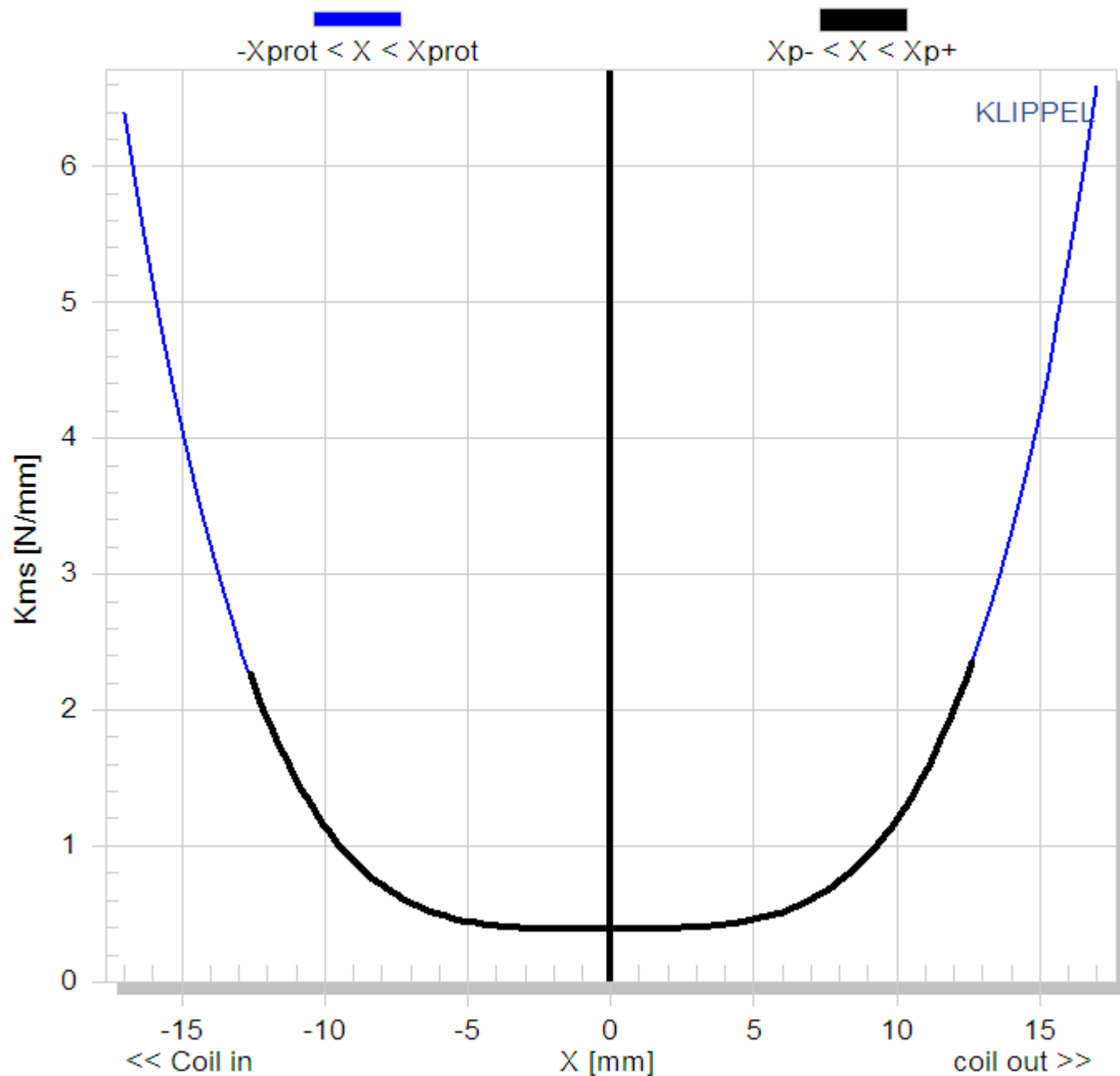
Ei (t)	12.9	%	error current measurement
Ex (t)	100.0	%	error laser measurement
Eu (t)	9.9	%	error amplifier check
Delta Tv (Delta Tlim)	53.7 (100.0)	K	increase of voice coil temperature (limit)
Blmin (Bllim)	48.1 (35.0)	%	minimal force factor ratio (limit)
Cmin (Clim)	25.1 (25.0)	%	minimal compliance ratio (limit)
P (Plim)	16.8314 (50.00)	W	real electrical input power (limit)
Lmin	78.3	%	minimal inductance ratio
Pn	28.257524	W	nominal electrical input power
P Re	11.914217	W	Power heating voice coil
Irms	1.748	A	rms value of the electrical input current
Urms	10.632	V	rms value of the electrical voltage at the transducer terminals
Ipeak	5.967	A	peak value of the electrical input current
Upeak	35.791	V	peak value of the electrical voltage at the transducer terminals
PC	1.61	dB	thermal power compression factor
Glarge (Gmax)	19.7 (26.0)	dB	gain of the excitation amplitude increased in the large signal domain (maximum)
Mech. system		abs.	import used to identify mechanical system in absolute quantities
Xdc	0.0	mm	dc component of voice coil excursion measured in the last update intervall
Xpeak	16.2	mm	positive peak value of voice coil excursion measured in the last update intervall
Xbottom	-14.4	mm	negative peak value (bottom) of voice coil excursion measured in the last update intervall
Xp+	12.6	mm	upper limit of displacement range (99% probability)
Xp-	-12.6	mm	lower limit of displacement range (99% probability)
Xprot	17.0	mm	maximal voice coil excursion allowed by protection system
v rms	0.85	m/s	voice coil velocity
Db	19.3	%	distortion factors representing contribution of nonlinear force factor
DI	3.9	%	distortion factor representing contribution of nonlinear inductance
Dc	42.1	%	distortion factor representing contribution of nonlinear compliance
R th total	4.51	K/W	Delta Tv / P Re

<b>Symbol</b>	<b>Number</b>	<b>Unit</b>	<b>Comment</b>

Generator (Property Page)			
Spectral characteristic	automatic:pink		
fhp	10	Hz	cut-off frequency of high pass (-3 dB)
flp	400	Hz	cut-off frequency of low pass (-3 dB)
Protection (Property Page)			
Delta Tlim	100	K	increase of voice coil temperature (limit)
Bllim	35.0	%	minimal force factor ratio (limit)
Clim	25.0	%	minimal compliance ratio (limit)
Plim	50.00	W	electrical input power (limit)
Gsmall	-14.0	dB	small-signal gain
Conditions (Property Page)			
Finish after step of	not activated		
Duration of 'Nonlinear Mode 5(7)'	10	min	
Speaker	1		

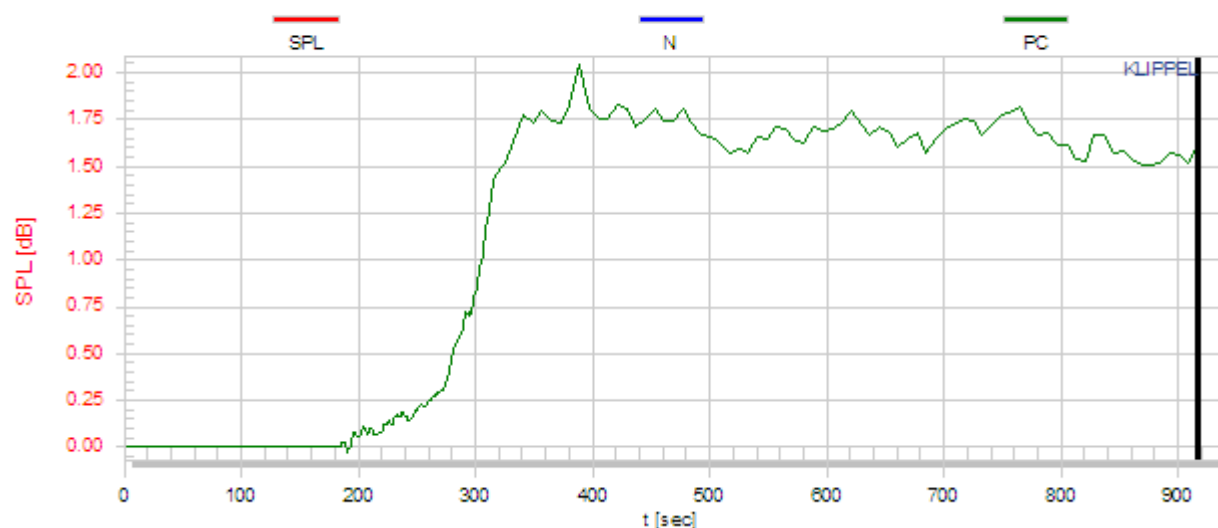
# Incremental Stiffness $K_{incr}(X)$

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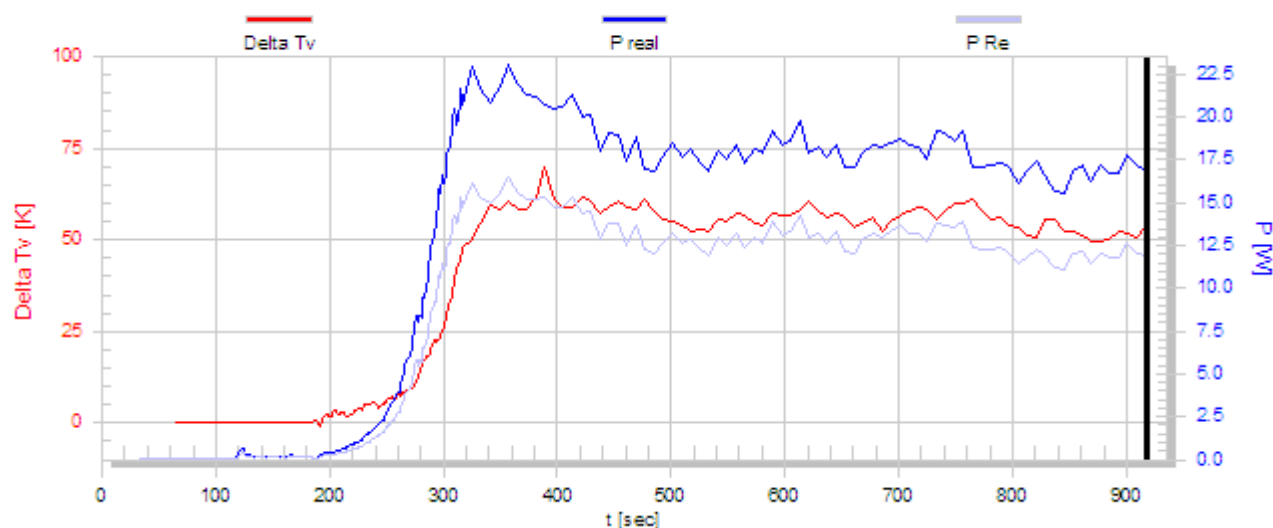
# Sound pressure level SPL (t), efficiency N (t) and thermal power compression PC (t)

(00:15:17)



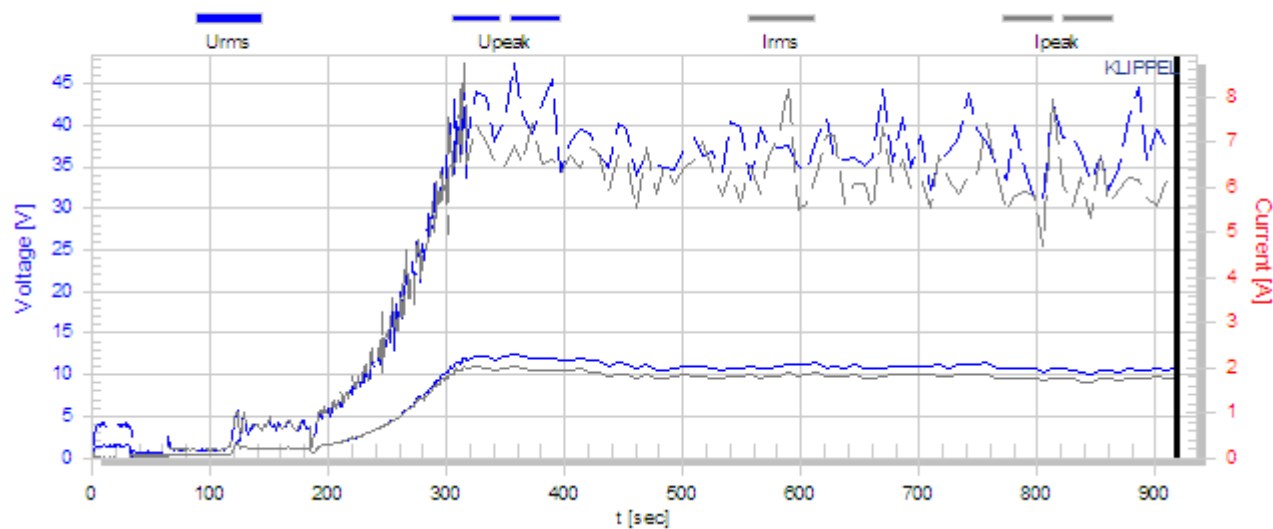
## Increase of voice coil temperature Delta Tv (t) and electrical input power P (t)

(00:15:17)



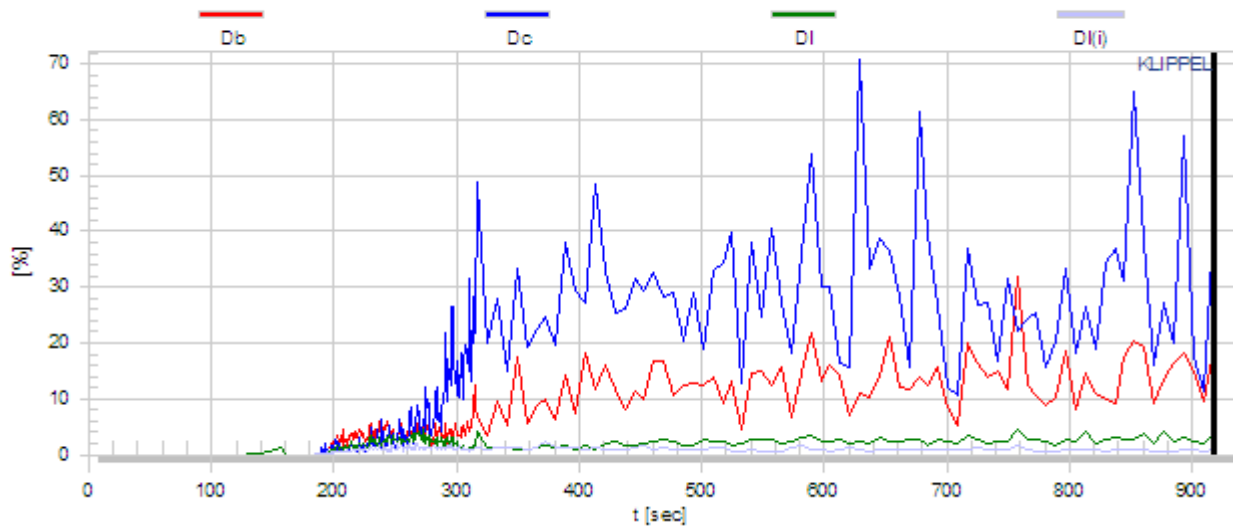
## Voltage Urms, Upeak (t) and current Irms, Ipeak (t)

(00:15:17)



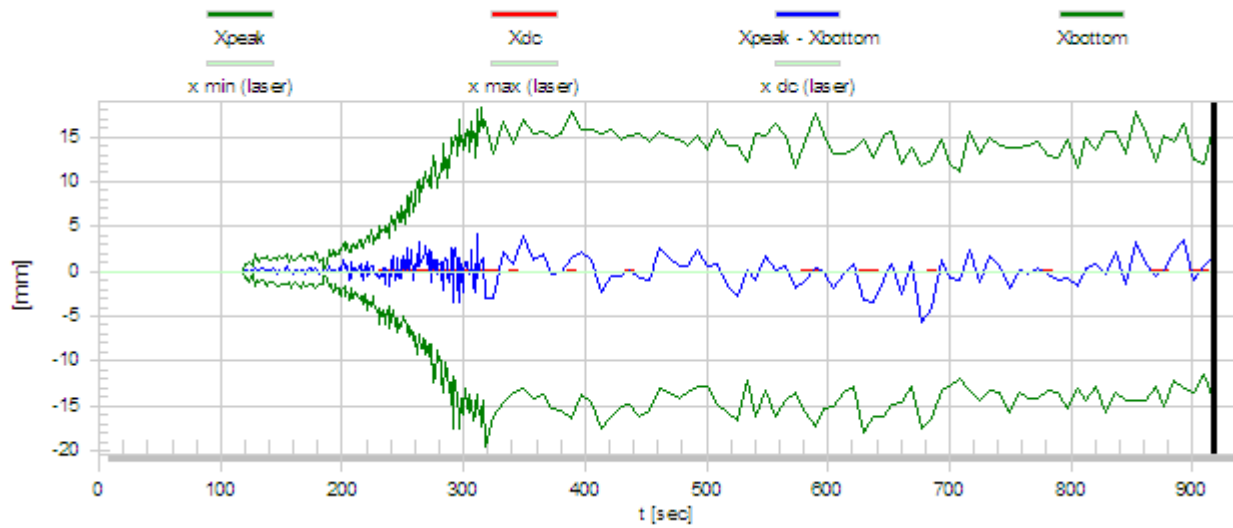
# Distortion analysis : Db (BI-product), Dc (suspension), DI (inductance)

(00:15:17)



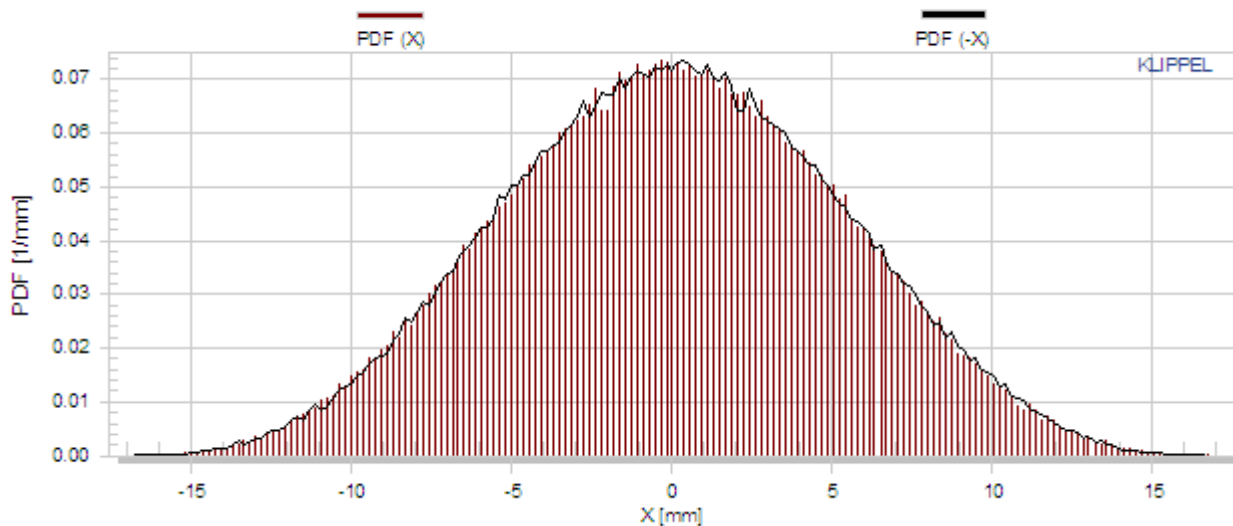
## Voice coil displacement

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## Displacement PDF (X) histogram

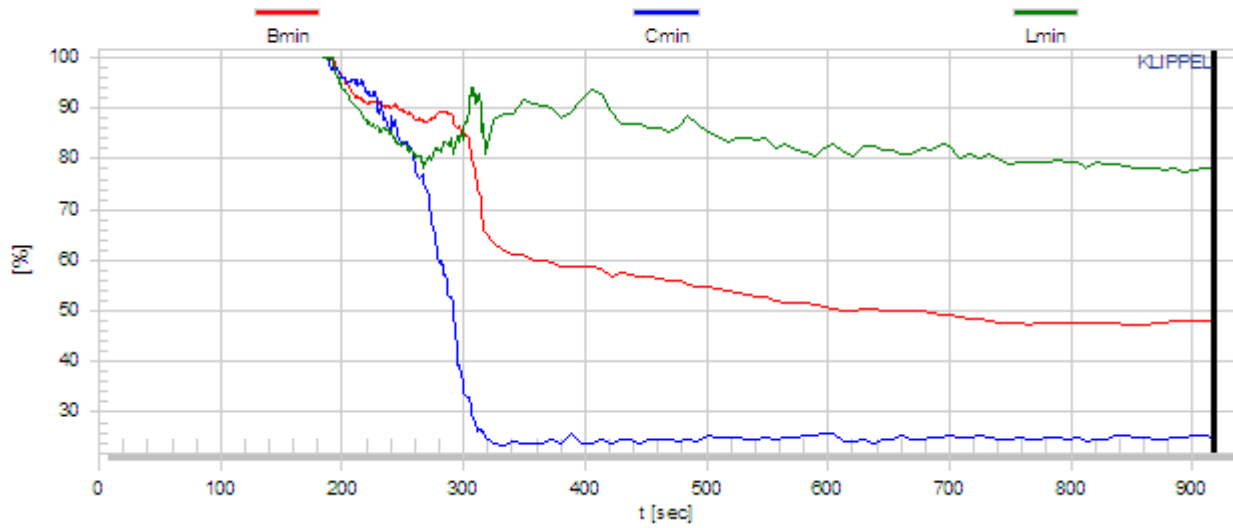
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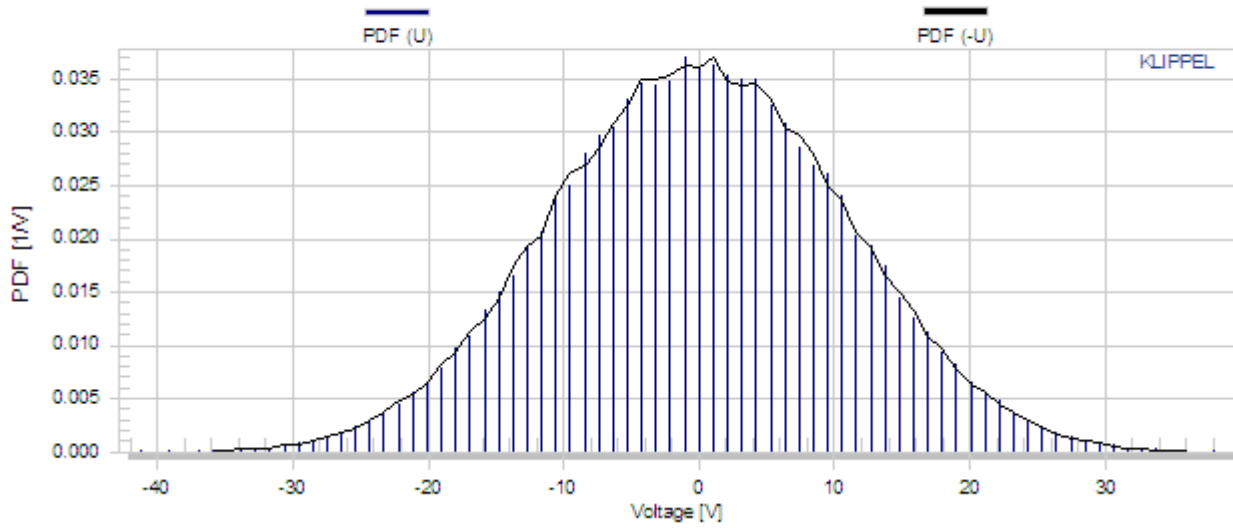
## Minimal parameter values

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## Voltage PDF (U) histogram

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- End