harman consumer group

Engineering Design Specification	Date	Rev #	Document Number
	10/18/2012	A	9990035

15 inch Woofer, Alnico, High Power and very Low Distortion Woofer

Model Number:	1501AL-1
Part Number:	320-0051-001
Division:	Harman Lifestyle
Where Used:	JBL Everest DD65000
Approved Supplier(s)	HAdM (Harman Mexico MFG)
Design Engineer:	JMoro

Assembled View:

Engineering Design Specification	Date	Rev #	Document Number
	10/18/2012	A	9990035

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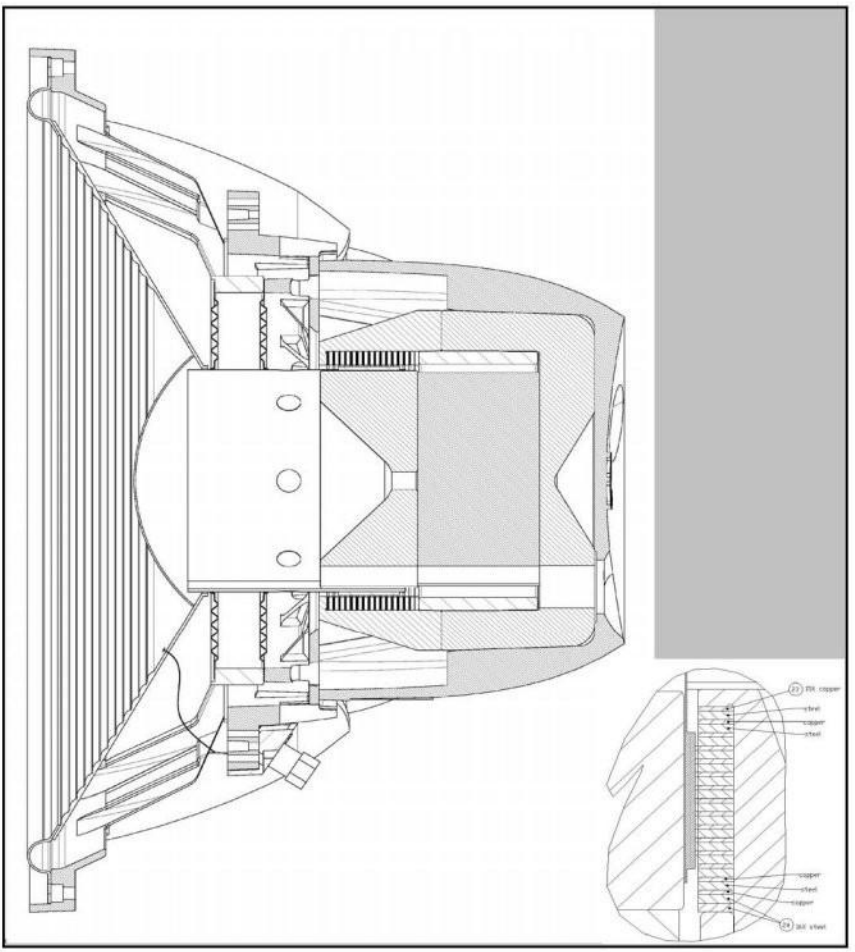
Section View

Model # 1501AL-1 Part # 320-0051-001



Document Revision History

Rev #	Date	Description of Change	ECO#	Approval	
				M.E.	T.E.
X1	6/15/2012			N/A	JM
X2	6/15/2012	Correct Klippel data		N/A	JM
X3	6/15/2012	Update Graphs		n/a	JM
X4	6/20/2012	Update Specs		n/a	JM
X5	10/18/2012	update specs		N/A	JM
A	10/18/2012	Release to production	5846	N/A	JM

Engineering Design Specification	Date	Rev #	Document Number
	10/18/2012	A	9990035

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Transducer Mechanical Characteristics

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Assembly

Mounting Diameter:	13.75 inches	Mounting Depth:	9.0 inches
Flange Diameter:	15.25 inches	Flange Depth:	0.76 inches
Mounting Detail:	8 recessed holes for #10 Philister head	Overall Depth:	9.875 inches
Other:			

Frame

Type:	Heavy wall Cast Aluminum	Material:	380 aluminum alloy
Color:	Dark Gray	Finish:	Textured Poweder Coat
Other:			

Diaphragm

Type:	Ribbed paper pulp cone - Straight body	Material:	Special Mogami formulation "B-45-SB"
Color:	Black	Finish:	Natural pulp - Semi Pressed
Other:	40 gram cone body damped with 15 gram Aquaplas coating, Used with Dust Dome of same material		

Surround

Type:	Half Roll	Material:	Low Density SBR Foamed Rubber
Color:	Black	Finish:	Smooth
Other:	Front attached to Cone Body, Surround Supplier (Chi Yih MFG)		

Spider

Type:	Equal roll (5) cloth spider	Material:	Hakken Nomex (N-24) with A/0.91 resin
Weave:	********	Color:	Brown
Other:	New taller sinusiodal roll design. Two spiders used with top spider inverted		

Front Gasket

Material:	None	Color:	N/A

Rear Gasket

Material:	None	Color:	N/A

Voice Coil

I.D.:	3.904 inches	Max. O.D.:	4.025
Wire Type:	Aluminum Ribbon, Edge wound	Wire Size:	1.270mm x 0.13378mm
Wire Turns:	168	Wire D.C.R.:	9.2
Winding Width:	25.4 mm (1.0 inch)	Winding layers:	1
Former:	7 mil FQG (Goto)	Wrapper:	2 layers of 5 mil NEC (Goto)
Other:	Used with Goto High Temperature Adhesive (type PRO-1)		

Magnet

Material:	Alnico 5DG	Thickness:	2.0 inches
O.D.:	3.82 inches - incldg 3 vents on O.D.	I.D.:	None
Other:			

Engineering Design Specification	Date	Rev #	Document Number
	10/18/2012	A	9990035

15 inch Woofer, Alnico, High Power and very Low Distortion Woofer

Transducer Mechanical Characteristics (Motor)

Model #	1501AL-1	Part #	320-0051-001

Top Plate

Material:	Low Carbon Steel (1215 or Equiv.)	Thickness:	1.60 inches
O.D.:	Tappered from 4.9 (at top) to 6.0 inches	I.D.:	4.079 inches
Other:	Special laminate configuration of 16 steel (.064" thk) and 15 copper (.032" thk) alternating layers		

Pole Piece

O.D.:	Low Carbon Steel (1215 or Equiv.)	Copper Cap:	none
Vent:	JBL "VCG" style Vented Gap Cooling (3 vents @120 degrees on O.D.)		
Other:	3.879 inch Pole O.D.		

Back Plate

Material:	Low Carbon Steel (1215 or Equiv.)	Thickness:	0.9 inch (back wall of Pot)
O.D.:	6.0 inches	I.D.:	4.578 / 4.556 inch
Other:	This is the POT or return circuit of Insider Alnico motor structure (see assembly drawing)		

Bucking Magnet

Material:	N/A	Thickness:	******
O.D.:	******	I.D.:	******
Other:			

Shielding Can

Material:	N/A	Thickness:	*****
Other:			

Misc

Terminal Size / Type:	5-Way Binding Posts (Red / Black)	Polarity:	E.I.A.
SFG Configuration:	Underhung Motor Topology (Long 1.6 inch Gap / Short 1.0 inch Coil)		
Flux Stabilizing Ring:	2 inch tall, Aluminum Conductive ring at motor base and 15 copper rings inside coil gap (on O.D. of coil)		
Tinsel Lead Type:	Silver Plated Copper - Twister topology		
Tinsel Lead Attach.:	Soldered to terminal and cone eyelets		
Other:			

Notes:

Engineering Design Specification	Date	Rev #	Document Number
	10/18/2012	A	9990035

15 inch Woofer, Alnico, High Power and very Low Distortion Woofer

Model # **1501AL-1** Part # **320-0051-001**

Transducer Electro-Mechanical Parameters

Fundamental Resonant Frequency (Hz):	Fs	19	+/-	10%
Transducer Direct Current Resistance (Ohms):	DCR	9.2	+/-	3%
Total Driver Q at Fs, Considering all driver Resistance:	Qts	0.20	+/-	5%
Moving Mass (g):	Mms	137	+/-	5%
Motor Strength (T*m):	Bl	27	+/-	5%
Voltage Sensitivity(2.83V@1 meter)	SPL	91dB,200Hz	+/-	1dB
Radiation Area	Sd	865.7 sq.cm.		

Method

Software:	Smith & Larson Audio Woofer Tester
Mass Loading:	150 grams
Misc.:	

Magnetic Flux Information (For Engineering Reference Only)

Total flux lines intercepted by coil windings [Maxwell Turns]:	411,700
Conversion to flux density [Tesla]:	0.517
Flux lines throughout gap thickness [Maxwell Turns]:	674,632
Conversion to flux density [Tesla]:	0.528

Notes

Parameters provided are nominal values which are closest to the Engineering Referance Standard

Voltage Sensitivity takes precedence over possible T/S combinations that would produce SPL

Magnetic Flux data measured with a 3.925 inch diameter, One-turn Search coil

Engineering Design Specification	Date	Rev #	Document Number
	10/18/2012	A	9990035

15 inch Woofer, Alnico, High Power and very Low Distortion Woofer

Transducer Test Specifications

production testing quantities per HCG QA AQL

Model # **1501AL-1** Part # **320-0051-001**

Polarity Test

Polarity: EIA STANDARD

Dynamic Test

Sine Sweep Voltage:	20 vrms (Audible rubb&buzz)
Frequency Range:	16 Hz to 400 Hz
Sweep Duration:	4 seconds

Power Test

Signal	Pink Noise, 50-500Hz, 6dB Crest Factor, 60vrms
Duration:	8 + 92 hours

Impedance

DC Resistance: 9.2 Ohms

Min. Impedance @ Frequency 12.0 Ohm @ 177 Hz

Frequency Response

Freq. Response:

Window	*Averaging*	*Slope*
60 - 700 Hz +/- 1.0 dB	1/3 Octave	36 dB / Octave
700 - 900 Hz +1.0 dB / -2.0 dB	1/3 Octave	36 dB / Octave
900 - 2000 Hz + 2.0dB / - 3.0dB	1/3 Octave	36 dB / Octave
	1/3 Octave	36 dB / Octave
	1/3 Octave	36 dB / Octave
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	1/3 Octave	36 dB / Octave

Notes:

Power test specification above must be EPR qualified at 100 hours.

2nd Harmonic Distortion to be about +/-5dB from 2nd Harmonic of authorized Line/QA Production Standard. This is to monitor off-center voice coils in magnetic gap or poor spider positioning.

Engineering Standard Measured Parameters	Date	Rev #	Document Number
	10/18/2012	A	9990035

15 inch Woofer, Alnico, High Power and very Low Distortion Woofer

Model # 1501AL-1 Part # 320-0051-001

1501AL-1 #2 DV Build Ver 5.00
Completed: Fri Jun 08 10:01:48 2012
Drive level 40.000 % [1.371 mA]
Sine,LoZP(LV/LA)->Vas,18 pts

Re	=	9.4363	ohms
Fs	=	18.4573	Hz
Zmax	=	527.8409	ohms
Qes	=	0.1936	
Qms	=	10.6344	
Qts	=	0.1901	
Le	=	1.5604	mH (at 1 kHz)
Diam	=	332.0000	mm (13.0709 in)
Sd	=	86569.7190	mm^2(134.1833 in^2)
Vas	=	564.5196	L (19.9358 ft^3)
BL	=	28.1555	N/A
Mms	=	140.2233	g
Cms	=	530.2521	uM/N
Kms	=	1885.8954	N/M
Rms	=	1.5292	R mechanical
Efficiency	=	1.7230	%
Sensitivity	=	94.3809	dB @1W/1m
Sensitivity	=	93.6638	dB @2.83Vrms/1m
Krm	=	30.861E-03	ohms Freq dependent resistance
Erm	=	603.653E-03	Rem=Krm*(2*pi*f)^Erm
Kxm	=	30.147E-03	Henries Freq dependent reactance
Exm	=	678.490E-03	Xem=Kxm*(2*pi*f)^Exm

Ftest	=	12.830	Hz
Ftest/Fms	=	0.6951	
Test Mass used	=	150.0000	g (Equal to 30.0 nickels)
Test Mass (Ft=Fms*0.90)	=	32.892	g (Add -117.108g for Ft=16.612)
Test Mass (Ft=Fms*0.75)	=	109.063	g (Add -40.937g for Ft=13.843)

$R_{MC} = 84.03$

[Page 1]

Engineering Standard Frequency Response	Date	Rev #	Document Number
	10/18/2012	A	9990035

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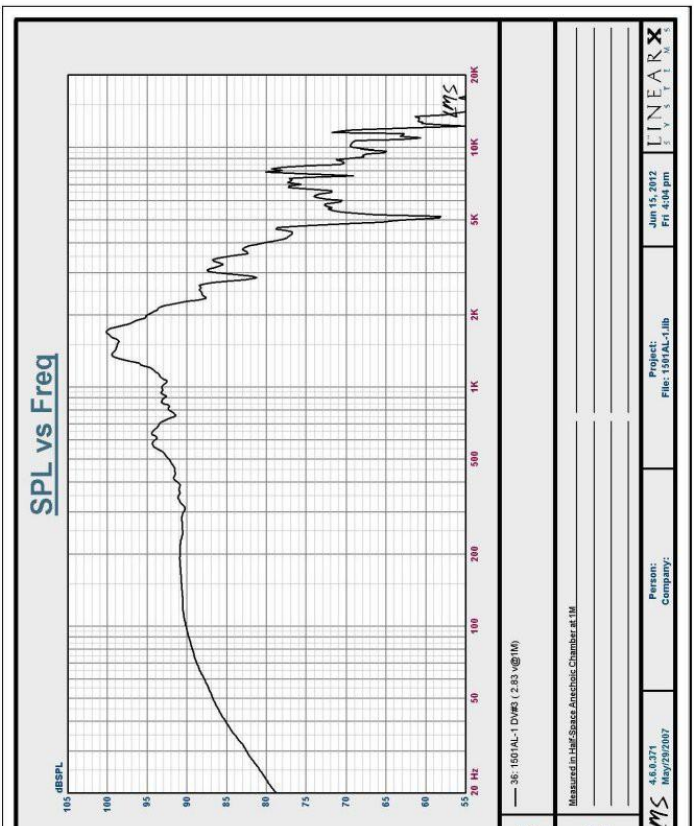

Engineering Standard Distortion (Low Level)	Date	Rev #	Document Number
	10/18/2012	A	9990035

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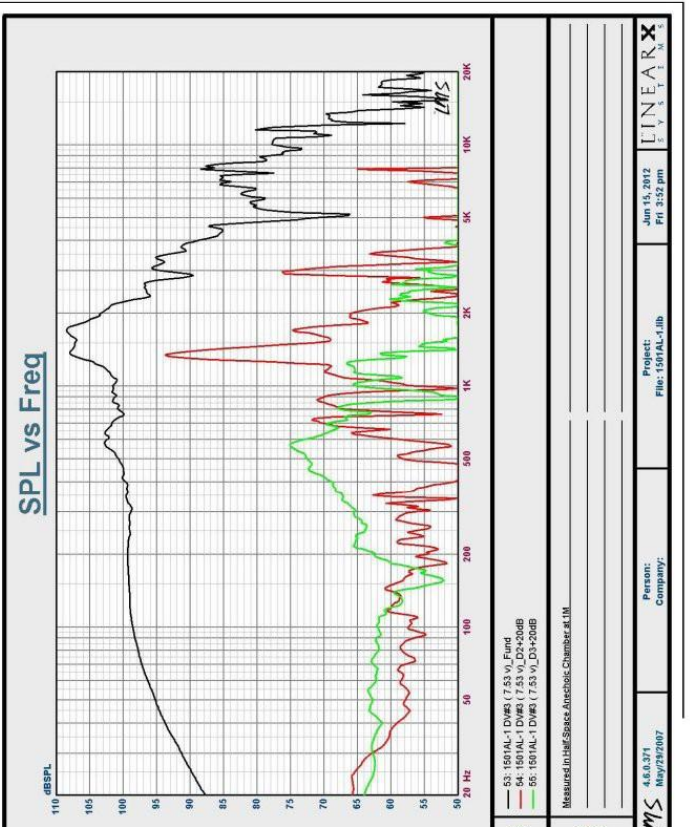
Model # **1501AL-1** Part # **320-0051-001**



Engineering Standard Distortion (High Level)	Date 10/18/2012	Rev # A	Document Number 9990035

15 inch Woofer, Alnico, High Power and very Low Distortion Woofer

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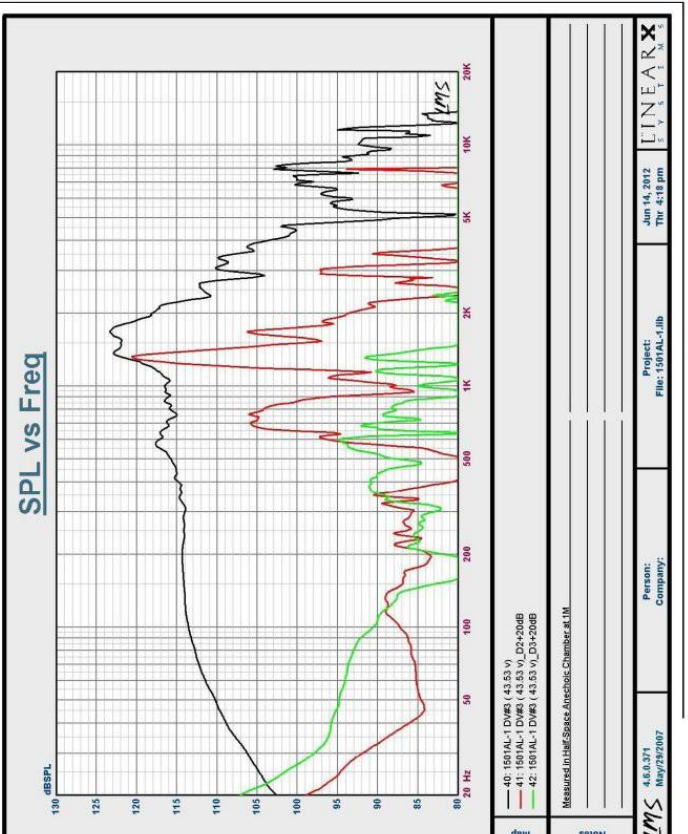

Engineering Standard Impedance	Date	Rev #	Document Number
	10/18/2012	A	9990035

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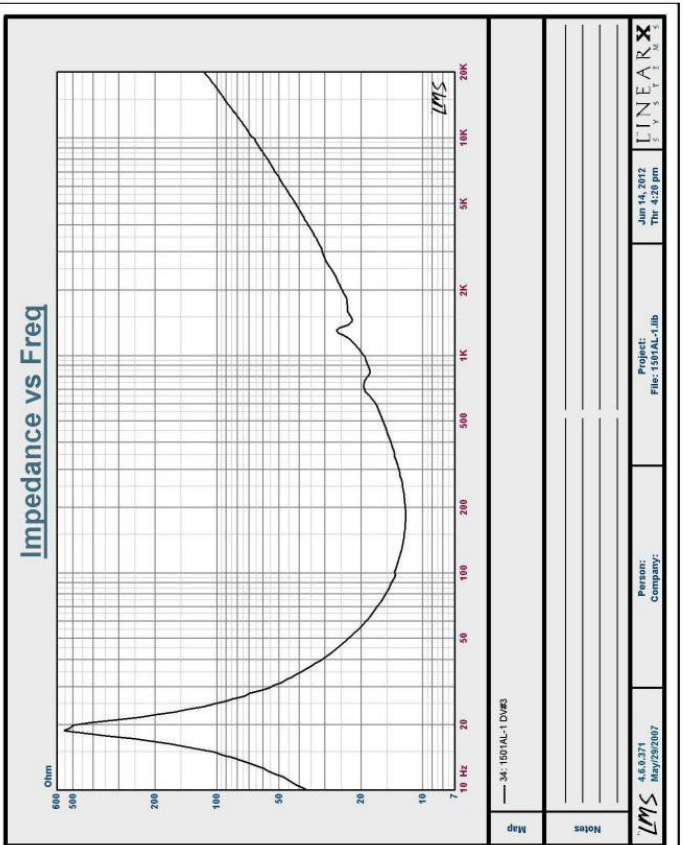

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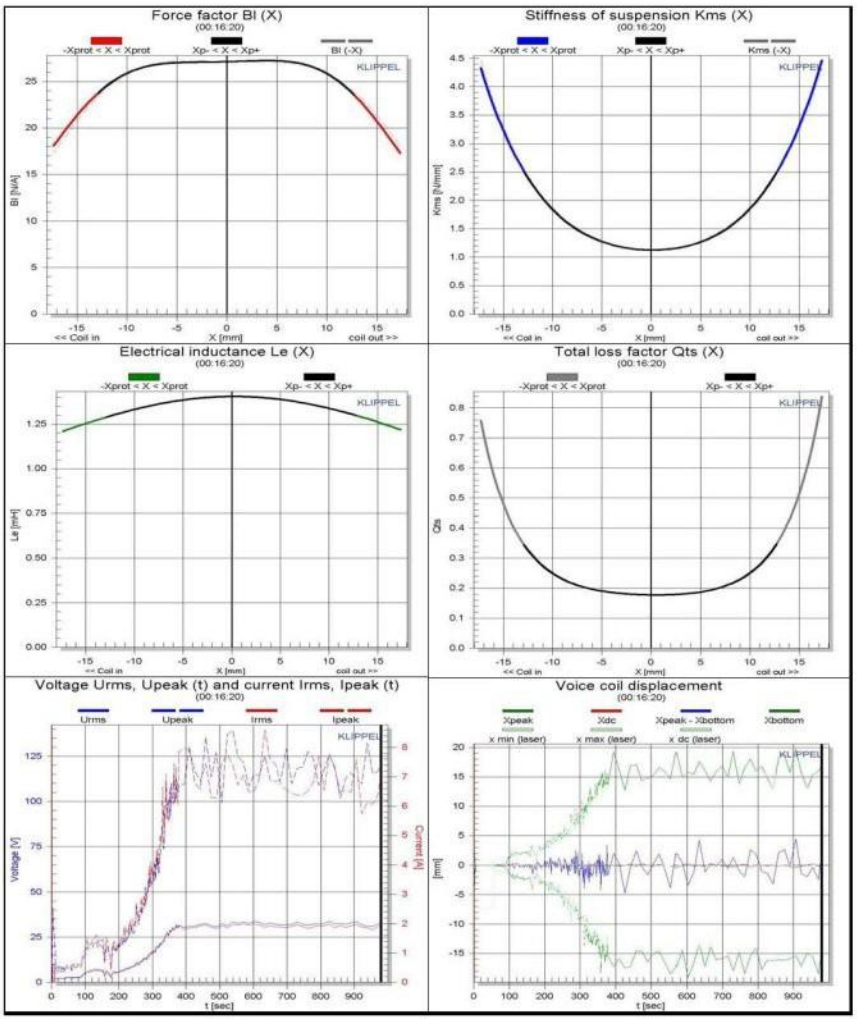

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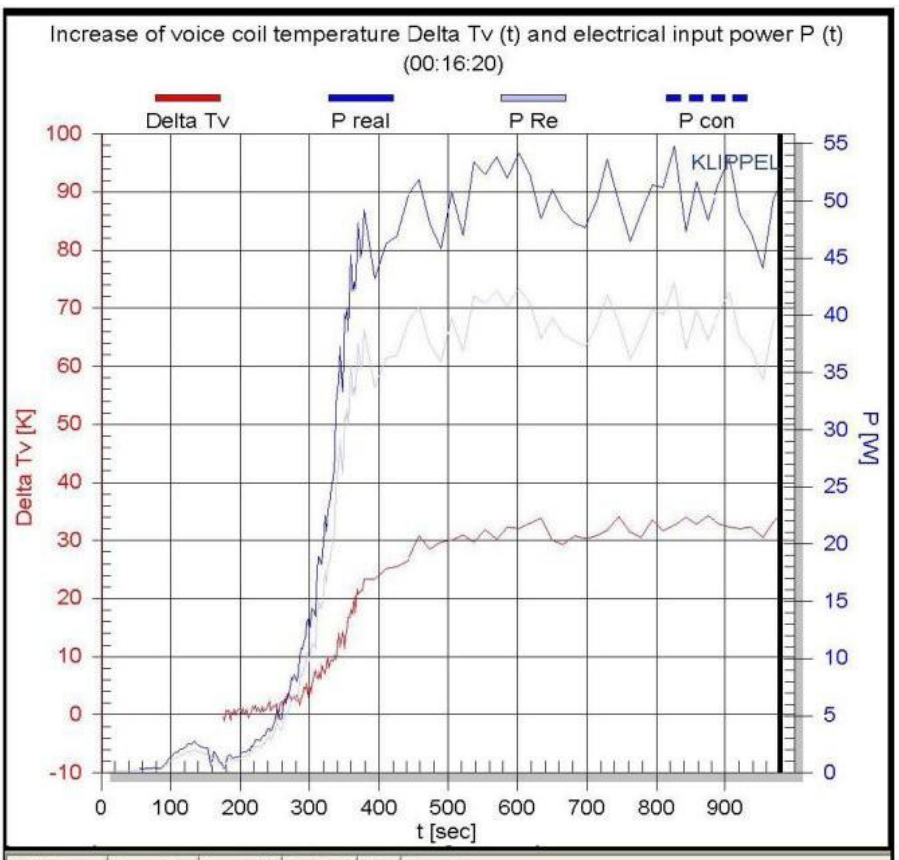

Symbol	Large + Warm	Large + Cold	Small Signal	Unit	Comment
Delta Tv = Tv-Ta	34	0	-0	K	increase of voice coil temperature during the measurement
Xprot	17.3	17.3	2.4	mm	maximal voice coil excursion (limited by protection system)
Re (Tv)	10.82	9.54	9.54	Ohm	(imported) voice coil resistance considering increase of voice coil temperature Tv
Le (X=0)	1.41	1.41	1.28	mH	voice coil inductance at the rest position of the voice coil
L2 (X=0)	1.32	1.32	1.21	mH	para-inductance at the rest position due to the effect of eddy current
R2 (X=0)	6.62	6.62	6.04	Ohm	resistance at the rest position due to eddy currents
Cmes (X=0)	288	288	264	µF	electrical capacitance representing moving mass
Lces (X=0)	423.07	423.07	311.07	mH	electrical inductance at the rest position representing driver compliance
Res (X=0)	256.64	256.64	149.13	Ohm	resistance at the rest position due to mechanical losses
Qms (X=0, Tv)	6.70	6.70	4.34		mechanical Q-factor considering Rms only
Qes (Tv)	0.18	0.16	0.20		electrical Q-factor considering Re (Tv) only
Qts (X=0, Tv)	0.18	0.16	0.19		total Q-factor considering Re (Tv) and Rms only
fs	14.4	14.4	17.6	Hz	driver resonance frequency
Mms	137.470	137.470	137.470	g	(imported) mechanical mass of driver diaphragm assembly including voice-coil and air load
Rms (X=0)	1.858	1.858	3.497	kg/s	mechanical resistance of total-driver losses
Cms (X=0)	0.89	0.89	0.60	mm/N	mechanical compliance of driver suspension at the rest position
Bl (X=0)	27.13	27.13	27.13	N/A	(imported) force factor at the rest position (Bl product)
Vas	937.5721	937.5721	630.3668	l	equivalent air volume of suspension
N0	1.470	1.666	1.666	%	reference efficiency (2Pi-sr radiation using Re)
Lm	93.8	94.4	94.4	dB	characteristic sound pressure level
Sd	865.70	865.70	865.70	cm²	diaphragm area

Symbol	Value	Unit	Comment
Mode	Nonlinear Mode 5(7)		
Record	205/205		
Laser	signal reliable		
t	00:16:20	h:min:s	measurement time
Ei (t)	7.6	%	error current measurement
Ex (t)	1.0	%	error laser measurement
Eu (t)	15.5	%	error amplifier check
Delta Tv (Delta Tlim)	34.3 (80.0)	K	increase of voice coil temperature (limit)
Blmin (Bllim)	66.2 (25.0)	%	minimal force factor ratio (limit)
Cmin (Clim)	26.7 (20.0)	%	minimal compliance ratio (limit)
P (Plim)	51.38 (50.00)	W	real electrical input power (limit)
Lmin	86.8	%	minimal inductance ratio
Pn	90.10	W	nominal electrical input power
P Re	40.32	W	Power heating voice coil
P con		W	deducted power due to convection cooling
Glarge (Gmax)	18.6 (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	17.0	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+	12.7	mm	upper limit of displacement range (99% probability)
Xp-	-12.9	mm	lower limit of displacement range (99% probability)
Xprot	17.3	mm	maximal voice coil excursion allowed by protection system
v rms	0.62	m/s	voice coil velocity
Irms	1.931	A	rms value of the electrical input current
Urms	32.881	V	rms value of the electrical voltage at the transducer terminals
Ipeak	7.126	A	peak value of the electrical input current
Upeak	121.245	V	peak value of the electrical voltage at the transducer terminals
PC	1.09	dB	thermal power compression factor
Db	11.2	%	distortion factors representing contribution of nonlinear force factor
Dl	1.0	%	distortion factor representing contribution of nonlinear inductance
Dc	23.1	%	distortion factor representing contribution of nonlinear compliance
R tc (v)		K/W	
R th total	0.85	K/W	Delta Tv / P Re