Microphones & Accessories A4

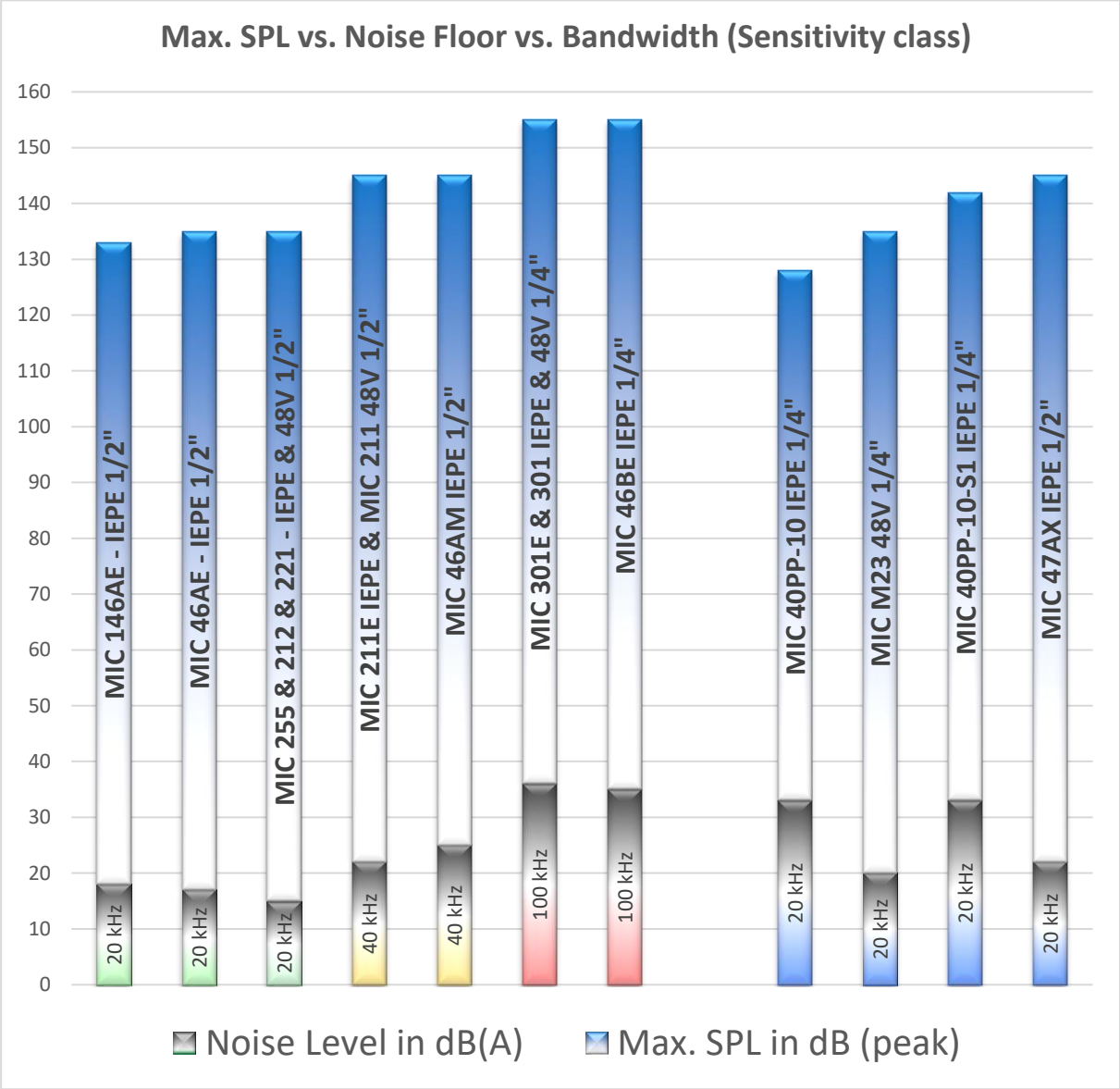
Accessories of the KLIPPEL ANALYZER SYSTEM (Document Revision 1.24)

FEATURES

- Microphones optimal for research, development and manufacturing of transducers
- Condenser and electret microphones
- High performance/cost ratio
- Complete sets
  (cartridge, preamp, clamp, case, cable, …)
- Customized solutions according to your needs

The KLIPPEL ANALYZER SYSTEM provides a spectrum of microphones ideal for transducer measurements in research, development and manufacturing. There are different solutions for applications where special constraints such as excellent performance, special climate conditions, robustness or minimal cost are considered. These sets comprise all components (cartridge, preamplifier, power supply, cables) which are required for the operation with the KLIPPEL Analyzers (KA3, PA, DA) and various additional test and clamping hardware.

CONTENTS:



Listed free field mics are tested and suggested mics for typical Klippel measurement applications.

All mics have IEPE current supply or 48 V Phantom powered preamplifiers for direct connection to the Klippel Analyzers thus no external signal conditioning preamplifiers are needed. The input voltage range of the Klippel Analyzer is matched to the output voltage range of the mics for using the full dynamic range without the need of recalibration when the pre-amplifier gain has been changed.

Most of them use pre-polarized Electret cartridges. One special preamplifier provides 200 V polarization voltage out of 48 V Phantom Power for external polarized condenser cartridges. In general, pre-polarized and external polarized measurement microphone cartridges are both very long-term stable.

External polarized “real” condenser mics for dedicated external 200 V supply units are on request. Comparing the same cartridge type used at an IEPE or Phantom powered pre-amplifier with a pre-amplifier for an external supply unit, the max. SPL could be about 12 dB higher. But using the full dynamic range requires to adjust the external supply unit input gain, which also requires recalibration. Also, the price of such a combination will be higher and it is often more beneficial to combine two IEPE or Phantom powered mics for different measurement ranges or measurement tasks.

Pressure field mics, special accessories and others are on request. Head- and torso simulators, ear-simulators with included microphones can be found in a separate specification document A14.
Klippel application engineers will suggest the right equipment for your measurement application.
Klippel is a registered sales partner of the wide range of acoustical measurement equipment from MTG (Microtech Gefell - Germany) and G.R.A.S. (Denmark).

1 High Sensitivity – Free Field – Measurement Microphones

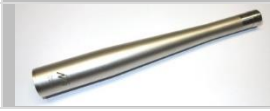
50 mV/Pa & 20 kHz class		Mic 255 IEPE ½" Set	Mic 212 IEPE ½" Set	Mic 221 48V ½" Set	Mic 46AE IEPE ½" Set	Mic 146AE IEPE ½" Set
Manufacturer		Microtech Gefell (Germany)			G.R.A.S. (Denmark)	
Preamp supply type		IEPE current supply		48V Phantom Power	IEPE current supply	
Connector type		BNC		XLR	BNC	
Default - rugged – compact - type		default	rugged	default	default	rugged
Cartridge polarization type		pre-polarized Electret		200V	pre-polarized Electret	
IEC 61094-4 designation		WS2F		WS2F	WS2F	
Max. SPL before clipping in dB @ KA3 / DA2 / PA (0 dB) (*1)		135		135	135	133
@ PA (with +10 dB preamp) (*2)		129		Production Analyzer has no 48V Phantom Power inputs	128	
Nominal sensitivity in mV/Pa (*3)		46.6		42.1	50	
Sensitivity series spread in dB (*4)		± 1.5		± 1.5	± 2	
Sensitivity range in mV/Pa (*5)		39.2 – 55.5		35.4 - 50	39.7 – 63.0	
Noise level (*6) in dB(A)		15		15	17	18
Frequency range ± 1 dB in Hz					5 – 10 k	
Frequency range ± 2 dB in Hz		3.5 – 20 k		3.5 – 20 k	3.15 – 20 k	
Characteristic		omnidirectional		omnidirectional	omnidirectional	
90° damping @ 20 kHz in dB		-8.4	-8.4	-9.0	-9.9	-10.5
Cartridge type		MK 255	MKS 221	MK 221	40 AE	complete mic
Preamplifier type		MV 210	MV 212	MV 225	26 CA	
Nominal cartridge diameter		½"		½"	½"	
Preamp diameter		½"		½" – 21 mm	½"	
Polarity (*7)		0°		0°	0°	
Integrated TEDS memory		IEEE 1451		-	IEEE 1451.4	
Set includes	Grid - cartridge - preamp	✓ - ✓ - ✓		✓ - ✓ - ✓	✓ - ✓ - ✓	
	Rugged grid - cal. adapter					2x - 1x
	Calibration chart	✓		✓	✓	
	Correction Curve (*13)	-		-	✓	
	Storage case	✓		✓	✓	
	Cable	5 m BNC-BNC		5 m XLR-XLR	5 m BNC-BNC	
	Mic clamp type - thread type	MH64 - 5/8"		MH22 - 5/8"	MK10 – 1/4"	
	Thread adapter	K&M 217 (5/8"o. - 3/8"i.) K&M 21770 (3/8"o. - 1/4"i.)		K&M 217 (5/8"o. - 3/8"i.) K&M 21770 (3/8"o. - 1/4"i.)	K&M 21920 (3/8"i. - 1/4"o.)	
Recommended for		RnD & QC		RnD & QC @ KA3 XLR Card or Soundcard	RnD & QC	
Typically on stock / default type		✓		✓		
Item number		2400-012	2400-615	2400-602	2400-501	2400-502
						

How to select:

1. Brand: MTG or G.R.A.S.? (MTG = good cost/performance ratio, G.R.A.S. = honored brand, correction curve)
2. IEPE or Phantom powered (BNC or XLR connector)?
3. Type: Default or rugged type, default or compact (NFS) type @ Phantom powered mics?
   (Rugged type for extended temperature range, wet and mechanical stressed conditions)
4. Go to Higher SPL - Wider Bandwidth class if max. SPL or bandwidth is limited for the desired application!

2 Higher SPL - Wider Bandwidth - Free Field - Measurement Microphones

Choose one of these mics only if max. SPL or bandwidth of the 50 mV/Pa & 20 kHz class mics is not sufficient!

10 mV/Pa & 40 kHz class		Mic 211E IEPE ½" Set	Mic 211 48V ½" Set	Mic 46AM IEPE ½" Set
Manufacturer		Microtech Gefell (Germany)		G.R.A.S. (Denmark)
Preamp supply type		IEPE current supply	48V Phantom Power	IEPE current supply
Connector type		BNC	XLR	BNC
Cartridge polarization type		pre-polarized Electret	200V	pre-polarized Electret
IEC 61094-4 designation		WS2F	WS2F	WS2F
Max. SPL before clipping in dB @ KA3 / DA2 / PA (0 dB) (*1)		145	145	145
@ PA (with +10 dB preamp) (*2)		142	Production Analyzer has no 48V Phantom Power inputs	139
Nominal sensitivity in mV/Pa (*3)		12.1	11.8	14.5
Sensitivity series spread in dB (*4)		± 1.5	± 1.5	± 2
Sensitivity range in mV/Pa (*5)		9.8 – 13.9	8.8 – 12.5	11.5 – 18.3
Noise level (*6) in dB(A)		22	22	25
Frequency range ± 1.5 dB in Hz		10 – 35 k	10 – 35 k	10 – 35 k
Frequency range ± 3 dB in Hz		10 – 40 k	10 – 40 k	10 – 40 k
Characteristic		omnidirectional	omnidirectional	omnidirectional
90° damping @ 20 kHz in dB		-9.0	-9.0	-9.7
Cartridge type		MK 211 E	MK 211	40 AM
Preamplifier type		MV 210	MV 225	26 CA
Nominal cartridge diameter		½"	½"	½"
Preamp diameter		½"	½" – 21 mm	½"
Polarity (*7)		0°	0°	0°
Integrated TEDS memory		IEEE 1451	-	IEEE 1451.4
Set includes	Grid - cartridge - preamp	✓ - ✓ - ✓	✓ - ✓ - ✓	✓ - ✓ - ✓
	Calibration chart	✓	✓	✓
	Correction Curve (*13)	-	-	✓
	Storage case	✓	✓	✓
	Cable	5 m BNC-BNC	5 m XLR-XLR	5 m BNC-BNC
	Mic clamp type - thread type	MH64 - 5/8"	MH22 - 5/8"	MK10 – 1/4"
	Thread adapter	K&M 217 (5/8"o. - 3/8"i.) K&M 21770 (3/8"o. - 1/4"i.)	K&M 217 (5/8"o. - 3/8"i.) K&M 21770 (3/8"o. - 1/4"i.)	K&M 21920 (3/8"i. - 1/4"o.)
Recommended for		RnD & QC	RnD & QC @ KA3 XLR Card or Soundcard	RnD & QC
Item number		2400-619	2400-618	2400-503
				

How to select:

1. Brand: MTG or G.R.A.S.? (MTG = good cost/performance ratio, G.R.A.S. = honored brand, correction curve)
2. IEPE or Phantom powered (BNC or XLR connector)?
3. Go to Max. SPL – Widest Bandwidth class if max. SPL or bandwidth is limited for the desired application!

3 Max. SPL - Widest Bandwidth - Free Field - Measurement Microphones

Choose one of these mics only if max. SPL or bandwidth of the 10 mV/Pa & 40 kHz mics is not sufficient!

5 mV/Pa & 100 kHz class		Mic 301E IEPE ¼" Set	Mic 301E 48V ¼" Set	Mic 301 48V ¼" Set	Mic 46BE IEPE ¼" Set
Manufacturer		Microtech Gefell (Germany)			G.R.A.S. (Denmark)
Preamp supply type		IEPE current supply	48V Phantom Power		IEPE current supply
Connector type		BNC	XLR	XLR	BNC
Cartridge polarization type		pre-polarized Electret	pre-polarized Electret	200V	pre-polarized Electret
IEC 61094-4 designation		WS3F	WS3F		WS3F
Max. SPL before clipping in dB @ KA3 / DA2 / PA (0 dB) (*1)		155	155		155
@ PA (with +10 dB preamp) (*2)		151	Production Analyzer has no 48V Phantom Power inputs		150
Nominal sensitivity in mV/Pa (*3)		3.2	2.9	3.6	3.6
Sensitivity series spread in dB (*4)		± 3	± 1.5		± 3
Sensitivity range in mV/Pa (*5)		2.2 – 4.6	2.4 – 3.5	3.0 – 4.3	2.5 – 5.1
Noise level (*6) in dB(A)		36	36	35	35
Frequency range ± 3 dB in Hz (*11) with protection grid mounted		5 – 25k	5 – 25k		4 – 28k
Frequency range ± 3 dB in Hz (*11) without protection grid		5 – 100k	5 – 100k		4 – 100k
Characteristic		omnidirectional	omnidirectional	omnidirectional	omnidirectional
90° damping @ 20 kHz in dB		-3.2	-3.2		-4.3
Cartridge type		MK 301 E	MK 301 E	MK 301	40 BE
Cartridge to preamp adapter			A67		
Preamplifier type		MV 310	MV 220	MV 225	26 CB
Nominal cartridge diameter		¼"	¼"		¼"
Preamp diameter		¼"	½"	½" – 21 mm	¼"
Polarity (*7)		0°	180° <= #1000 0° >= #1001	0°	0°
Integrated TEDS memory		IEEE 1451	-		IEEE 1451.4
Set includes	Grid - cartridge - ¼" to ½" adapter - preamp	✓ - ✓ - - - ✓	✓ - ✓ - ✓ - ✓		✓ - ✓ - - - ✓
	Calibration chart	✓	✓		✓
	Correction Curve (*13)	-	-		✓
	Storage case	✓	✓		✓
	Cable	5 m Microdot to BNC	2 m XLR (permanent connected)	5 m XLR-XLR	5 m Microdot to BNC
	Mic clamp type - thread type	MH64.2 - 5/8"	MH64 - 5/8"	MH22 - 5/8"	AL0029 – ¼"
	Thread adapter	K&M 217 K&M 21770	K&M 217 (5/8"o. - 3/8"i.) K&M 21770 (3/8"o. - 1/4"i.)		K&M 21920 (3/8"i. - 1/4"o.)
Recommended for		RnD & QC	NFS HW rev. >=1.0.9	RnD & QC @ KA3 XLR Card or SC	RnD & QC
Item number		2400-612	2400-616	2400-607	2400-507
					

How to select:

1. Brand: MTG or G.R.A.S.? (MTG = good cost/performance ratio, G.R.A.S. = honored brand, correction curve)
2. IEPE or Phantom powered (BNC or XLR connector)?
3. Type: Selection only at Phantom powered mics:
   Compact Electret type with a fixed cable or a larger condenser type with a removable cable?

4 Special Application Microphones

Choose one of these alternatively or additionally for special applications only!

Special Application Microphones		Mic 40PP-10 IEPE ¼" Set	Mic 40PP-10-S1 IEPE ¼" Set	Mic 47AX IEPE ½" Set	Mic M23 48V ¼" Set
Manufacturer		G.R.A.S. (Denmark)			Earthworks
Preamp supply type		IEPE current supply			48V Phantom Power
Connector type		BNC		Microdot	XLR
Cartridge polarization type		pre-polarized Electret			pre-polarized Electret
IEC 61094-4 designation				WS2P	
Max. SPL before clipping in dB @ KA3 / DA2 / PA (0 dB) (*1)		128	142	145	135
@ PA (with +10 dB preamp) (*2)		128	142	139	Production Analyzer has no 48V inputs
Nominal sensitivity in mV/Pa (*3)		50	9	12,5	34
Sensitivity series spread in dB (*4)		± 2	± 3	± 2	t.b.d.
Sensitivity range in mV/Pa (*5)		39.7 - 63	6.4 – 12.7	8.9 – 17.7	t.b.d.
Noise level (*6) in dB(A)		33	33	22	20
Frequency range ± 1 dB in Hz				5 – 12.5k	
Frequency range ± 1.5 dB in Hz		50 – 5k			
Frequency range ± 2 dB in Hz		10 – 20k		3.15 – 20k	
Frequency range + 1 / - 3 dB in Hz					3 – 23k
Characteristic		omnidirectional			omnidirectional
90° damping @ 20 kHz in dB		t.b.d.			t.b.d.
Cartridge type / pre-amplifier type		complete mic in one piece			complete mic
Nominal cartridge diameter		¼"	¼"	½"	¼"
Preamp diameter		7 mm		18 mm	22 mm
Polarity (*7)		0°			0°
Integrated TEDS memory		IEEE 1451.4	IEEE 1451.4	IEEE 1451.4	-
Set includes	Cartridge - preamp - grid	all in one piece		cartridge & preamp in one piece, grid removable	all in one piece
	Calibration chart	✓			✓
	Correction Curve (*13)	✓			✓
	Storage case	✓			✓
	Cable	5 m BNC-BNC		1.5 m Microdot (permanent connected) 2 m BNC-BNC 10 m BNC-BNC	5 m XLR-XLR
	Adapter			Microdot – BNC m. 2x BNC female – BNC female	1/2" calibration adapter
	Mic clamp type - thread type	AL0028 – 1/4"		rubber belt	EW22 - 5/8"
	Thread adapter	K&M 21920 (3/8"i. - 1/4"o.)			EW (5/8"o. - 3/8"i.) K&M 21770
Recommended for		QC SCN-NF	QC, LST, MPM, MSPM, SPM-Lite	NFS Synchronization	RnD & QC @ KA3 XLR Card
Typically on stock / default type		✓	✓		
Item number		2400-350	2400-360	2400-508	2400-700
					

How to select: Select it according to its recommended application!

5 Hints for Microphone Selection

Maximum SPL level and inherent noise level vs. sensitivity and cartridge diameter:

- Mics with higher sensitivity values typically have lower noise levels but also reduced max. SPL levels than comparable mics with lower sensitivity values and increased max. SPL capabilities.
- Mics with larger cartridge diameters typically have lower noise levels than comparable mics with smaller cartridge diameters.

Bandwidth vs. sensitivity and cartridge diameter:

- Mics with lower sensitivity values typically have a wider bandwidth than comparable mics with higher sensitivity values.
- Mics with smaller cartridge diameters typically have a wider bandwidth than comparable mics with a larger cartridge diameter.

Directivity vs. cartridge diameter:

- Measurement microphones are typically omnidirectional, although they have a type depending directivity, resulting in an increased off-axis damping to higher frequencies.
- Mics with smaller cartridge diameter typically have a lower high frequency damping for off-axis incidence than comparable mics with a larger cartridge diameter.

Selection criteria:

- For measurement applications choose the mic with the highest available sensitivity, which fulfills the given max. SPL and bandwidth requirements. Consider the directivity for special application.
- For sensitive Rub & Buzz testing and high-level SPL testing maybe separate mics are beneficial.

  This could be a combination of a highly sensitive, low noise 50 mV/Pa mic with a higher SPL, 10 or 5 mV/Pa mic.
- QC applications: For ambient noise detection 50 mV/Pa microphones with the highest possible sensitivity should be used as noise microphone. Measurement and noise microphone should have the same sensitivity, if test is operated without test enclosure / in free air.
- QC applications with Production Analyzer: Max. SPL depends on used preamplifier in hardware unit. Production Analyzer units have 10 dB input preamplifier by default. This can be changed to 0 dB on request.

Bandwidth limitation by the microphone type:

Limitations are caused by the physical dimension, especially cartridge diameter and other properties such as diaphragm tension which results in a certain sensitivity.

- ½" measurement microphones are limited to: f_{max} <= 40 kHz (type depending even less)
  The linearity can be achieved with the protection grid mounted. It is recommended to keep the microphone grid mounted all the time.
- ¼" measurement microphones are limited to: f_{max} <= 100 kHz (type depending even less)
  The specified linearity above 30 kHz can only be achieved without the protection grid mounted. It is recommended to keep the protection grid mounted for all measurements up to about 25 kHz. Remove the proception grid only for measurements above 25 kHz if highest accuracy is required. Take care the microphone diaphragm is very sensitive.

Bandwidth limitation by the input device:

- KA3 - Klippel Analyzer - XLR Card - XLR inputs: f_{max} = 87 kHz (Fs = 192 kHz, +0/-1.5 dB)
- KA3 - Klippel Analyzer - Laser Card - BNC inputs: f_{max} = 66 kHz (Fs = 192 kHz, -3 dB)
- DA2 (discontinued) - XLR & BNC input: f_{max} = 44 kHz (Fs = 96 kHz, -3 dB)
- PA – Production Analyzer - XLR & BNC input: f_{max} = 40 kHz (Fs = 96 kHz, +0/-0.3 dB)
- KA3 is needed for measurements above 44 kHz up to 88 kHz. KA3 XLR Card is recommended for measurements above 49 kHz (see KA3 XLR & Laser Card specification).

Phantom Power or IEPE Supply vs. cable length:

- Mics with IEPE supply are standard in measurement laboratories. To ensure electromagnetic compatibility they use coaxial cables and connectors. ½" mics use BNC connectors. ¼" mics are available with BNC, Microdot or SMB connector.
- Phantom powered mics are standard in recording studios and for live sound applications. They are also suitable for measurement applications. To ensure electromagnetic compatibility they use balanced cables and XLR connectors.
- Longer cable length are less critical at the KA3 - Laser Card - BNC inputs with increased IEPE supply current, compared to DA2 or PA BNC inputs.
- Longer cable length are less critical at the KA3 - Laser Card - BNC inputs, compared to the KA3 - XLR Card - XLR inputs (see below).
- Longer cable length are less critical at the DA2 - Phantom powered - XLR inputs, compared to the DA2 - IEPE powered - BNC inputs, due to the lower IEPE supply current.

IEPE powered mics could also be used at Phantom powered inputs using a standard XLR male to BNC female adapter (see chapter Adapter). As the adapter permanently shorts the negative side of the Phantom Power supply it could only be verified with Klippel Analyzer 3 – KA3 and the Klippel offered IEPE powered mics. Even the connection between the adapter and the XLR input channel will remain an unbalanced connection! For longer cable length, see chapter *Estimated Max. Cable Length.*

Frequency Response Accuracy:

- All offered microphones are manufacture-calibrated, which includes that the frequency response accuracy is checked for each specimen. The frequency response deviation of the shipped specimen will be smaller than the specified tolerance listed in this document or the manufacture specification.
- All offered microphones are shipped with calibration chart showing the specimens frequency response.
- Not for all offered microphones the manufacture offers the frequency response curve in a digital format for using it as a correction curve in the measurement software.
- If the frequency response accuracy should be increased by using a correction curve select a microphone with the "Correction Curve [*13]" included. See also next chapter *Microphone Calibration* / Accuracy level 4.
- Note: High frequency accuracy often depends a lot on the microphone positioning as well. Not in all measurement situations the effort for using a correction curve is required, recommend or beneficial, as long as a calibrated high-quality measurement microphone will be used.

6 Microphone Calibration, Ambient Conditions & Accuracy

6.1 Microphone Calibration

High quality measurement microphones are very stable over time and have very low temperature, humidity and air pressure coefficients resulting in small deviation of the manufacturer's measured sensitivity to the actual sensitivity. Different accuracy levels for calibrating a certain microphone in its final application are offered:

Accuracy level 1 – using nominal sensitivity – type depending calibration:

Using the nominal sensitivity specified in the tables in this document represents accuracy level 1. Since dB-Lab 212 default sensor files for all Klippel offered microphones using the nominal sensitivity are included in the software. The accuracy provided by these general templates is typically sufficient for daily laboratory measurements and near field measurements that are influenced by the measurement distance a lot.

Accuracy level 2a – using specific manufacture determined sensitivity – specimen depending calibration:

Using the specific sensitivity of a certain microphone measured by the manufacturer under reference temperature, humidity and air pressure conditions offers an increased accuracy without a significantly increased effort. This specific sensitivity will be found on the calibration chart provided by the manufacturer. Klippel performs a verification during the incoming inspection of each microphone and writes this sensitivity value at a sticker on top of the microphone case.

Accuracy level 2b – using specific accredit laboratory determined sensitivity – specimen depending re-calib.:

Depending on actual rules for re-calibration of measurement equipment the microphone should be periodically re-calibrated by an accredited laboratory under reference conditions.

Accuracy level 3a – determine in-situ sensitivity – specimen depending in-situ calibration:

Calibrating a microphone with the help of a pistonphone or calibrator increases the accuracy as it includes the whole measurement chain and considers the actual ambient conditions. This in-situ determined sensitivity could be verified by a comparison with the sensitivity calibrated according 2a or 2b.

Accuracy level 3b – determine in-situ sensitivity – specimen depending in-situ verification:

If using the sensitivity determined by an accredited laboratory is mandatory to fulfill official measurement requirements the specimen depending calibration according 2a or 2b could be verified by an in-situ verification using a pistonphone or calibrator. This verification includes the whole measurement chain and considers the actual ambient conditions.

Accuracy level 4 – considering frequency response correction curve – specimen depending correction:

The highest level of accuracy can be reached by combining the calibration according 2a, 2b or 3a by importing a frequency response correction curve for the particular microphone. The microphone correction curve can be found in the calibration chart provided by the manufacture. See also previous chapter *Hints for Microphone Selection* / Frequency Response Accuracy.

Frequency and level for calibration / verification according 3a or 3b:

- Microphone calibration will typically be done at 250 Hz or 1 kHz and 94 dB or 114 dB.
- Older calibrators are only offering 1 kHz, newer ones allow to select the frequency.
- Calibrating microphones at 250 Hz is recommended for ½" and larger cartridges. The pressure stasis could cause small deviation at higher frequencies. Therefore the G.R.A.S. 42AG Multifunction Sound Calibrator is the recommended type for most application and a flexible usage for all microphone types. It is recommended to use 250 Hz if the used calibrator supports it.
- Calibrating at 114 dB is recommended due to the resulting better SNR, although the calibration process is adjusted automatically to give reliable results also at 94 dB.
- Using 94 dB is typically only required for microphones using an external microphone pre-amplifier with a gain stage used for low signal level measurements.

6.2 Ambient Condition

Reference ambient condition:

The sensitivity referenced by the manufacturer or accredited laboratory is valid for the following reference ambient condition:

Temperature: 23 °C Relative humidity: 50 % Static air pressure: 101 kPa

Operating ambient condition:

Measurement microphones typically have a wide ambient condition range specified.

Manufacture	Type	minimum temperature in °C	maximum temperature in °C	minimum humidity in %	maximum humidity in % (non-condensing)
MTG	standard type	-25	100	0	100
MTG	rugged type	-40	125	0	100
G.R.A.S.	standard type	-30	85	0	90
G.R.A.S.	rugged type	-40	125	10	90
G.R.A.S.	flat mount type	-30	70	0	90
G.R.A.S.	7 mm type	-10	50	t.b.d.	t.b.d.
Earthworks		-20	60	t.b.d.	t.b.d.

Ambient condition influence:

Manufacture	Type	"temperature coefficient in dB/K"	"humidity coefficient in dB/%"	"pressure coefficient in dB/kPa"
MTG	standard type	0.01	t.b.d.	0.01
MTG	rugged type	0.01	t.b.d.	0.01
G.R.A.S.	standard type	-0.01	-0.001	-0.007 – 0.014
G.R.A.S.	rugged type	0.01	-0.001	-0.003
G.R.A.S.	flat mount type	-0.01	-0.001	-0.008
G.R.A.S.	7 mm type	t.b.d.	t.b.d.	t.b.d.
Earthworks		t.b.d.	t.b.d.	t.b.d.

Recommended ambient condition:

To ensure that the resulting sensitivity will be close to the manufacturer's specified sensitivity it is recommended to ensure IEC 60268 measurement condition for the device under test as well as for the used measurement microphone.

Temperature: 15 - 35 °C

Relative humidity: 25 - 75 %

Static air pressure: 86 - 106 kPa

Accuracy

Sensitivity deviation due to ambient condition changes:

Using above listed coefficients and assuming a worst-case scenario where temperature, humidity and pressure having actual values resulting in the maximum possible deviation, the deviation within the recommended IEC measurement range will be small.

MTG:	<= 0.27 dB	sensitivity deviation to reference sensitivity within IEC 60268 conditions
G.R.A.S.:	<= 0.28 dB	sensitivity deviation to reference sensitivity within IEC 60268 conditions

Calibration equipment accuracy:

Klippel's recommended calibrator 42AG provides its calibration signal with an accuracy of +/- 0.2 dB.

(The more expensive 42AC pistonphone provides its calibration signal with an accuracy of +/- 0.05 dB.)

Considering the calibration accuracy of the used measurement device microphone input channel an overall accuracy can be assumed.

Measurement Microphone:	<= 0.3 dB (climate influence within IEC 60268 measurement condition)
Microphone Calibrator:	<= 0.2 dB (device type depending, see above)
Microphone input channel:	<= 0.1 dB (device type depending, see HW device specification)

Typical deviation:

Above consideration of the maximum possible deviation allows us to give following suggestion:

- Microphone calibration according accuracy level 2a or 2b verified with accuracy level 1:
  The specific sensitivity of a microphone specimen determined by the manufacture or an accredited laboratory should be within the allowed sensitivity range specified by the manufacture.
  Typically +/- 1.5 to +/- 3 dB. Values for each microphone could be found in this document.
- Microphone calibration according accuracy level 3a or 3b verified with accuracy level 2a or 2b:
  The specific sensitivity of a microphone specimen calibrated or verified with a calibrator or pistonphone within IEC 60268 measurement ambient conditions should deviate to the specific sensitivity determined by the manufacture or an accredited laboratory at reference conditions by typically less than +/- 0.5 dB.
- Microphone calibration according accuracy level 3a or 3b verified with accuracy level 1:
  This verification variant combines both previous described deviations, thus the series spread represented in the +/- 1.5 to +/- 3 dB has to be combined with the ambient conditions and measurement chain considering additional +/- 0.5 dB.

In case of increased deviation to the above listed typical ranges the repeatability should be verified by repeated tests.

In case of permanently increased deviation to the above listed typical ranges the reliability could be verified by cross-checks with other microphones, calibrators, measurement device input channels or measurement devices.

Finally, the re-calibration of any device in the signal chain the microphone, calibrator and measurement device should be considered.

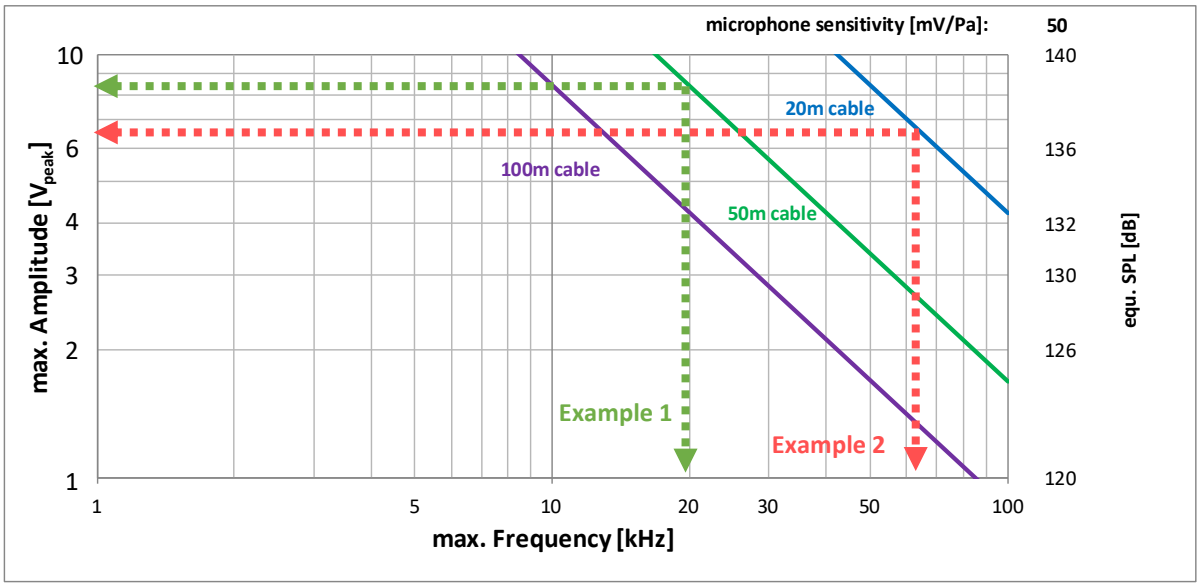
7 Estimated Max. Cable Length

7.1 IEPE Powered Microphones

CONDITIONS	The charts below are estimations of maximal applicable cable length for IEPE powered microphones with the following assumptions: • BNC cable: capacity per length: C' = 100 pF / 1 m • Minimum current to drive microphone amplifier: I = 2 mA. The IEPE current is actually split into mic pre-amplifier and cable driving. The excessive current for driving the cable is different for KA3 and PA/DA, namely 5.3 mA for KA3 and 1 mA for PA/DA. • Y-axis: Peak voltage of output signal. • X-axis: Maximum frequency of recorded microphone signal • Typical symptoms for exceeded cable length are high frequency signal attenuation and signal distortion.

CALCULATION	Following equation was used to determine the curves:
	$$A_{\text{peak}}[\text{V}] = \frac{I\,[\text{mA}] * 1e^{6}}{C'\left[\frac{\text{pF}}{\text{m}}\right] * 2 * \pi * L[\text{m}] * f\,[\text{kHz}]}$$
	To determine the peak output voltage of a microphone at a given SPL and sensitivity, use the following formula:
	$$\text{V}_{\text{peak}}[\text{V}] = \frac{S_{\text{Mic}}\left[\frac{\text{mV}}{\text{Pa}}\right] * 10^{\left(\frac{\text{SPL}-94\text{dB}}{20}\right)}}{1000}$$
	Maximum frequency, cable length and amplitude/SPL do have linear relationship. See following examples on how to convert the chart values to your specific application/setup.
	• E.g. 10 m cable length → half as much as 20 m cable → compared to "20 m cable" graph, it can be either
	  ○ twice as much amplitude or
	  ○ twice as much bandwidth possible
	• Reducing the microphone sensitivity by a factor of 5 (e.g. 10 mV/Pa instead of 50 mV/Pa) → amplitude stays the same but it can be either
	  ○ 5 times more SPL (+14 dB) using the same max frequency or
	  ○ 5 times more bandwidth using the same SPL

7.2 Limitations for KA3 devices (IEPE)



Example 1:

Operating the KA3 BNC microphone input with a common 50 mV/Pa microphone at 20 kHz maximum frequency and 50 m BNC cable.

According to the plot, the peak amplitude is above 8 V_{peak}.

To get a more accurate value, calculation can be done using the equation above:

$$A_{\text{peak}}[\text{V}] = \frac{5.3\ [\text{mA}] * 1\text{e}^6}{100\left[\frac{\text{pF}}{\text{m}}\right] * 2 * \pi * 50[\text{m}] * 20[\text{kHz}]} = 8.4\text{V}_{\text{peak}}$$

That amplitude equals a little more than 138 dB SPL for 50 mV/Pa microphone sensitivity, which is beyond the microphone limit of 135dB.

Example 2:

Operating the KA3 BNC microphone input with a microphone of just 4 mV/Pa sensitivity at a maximum frequency of 66 kHz using a 20 m cable. Microphone of less sensitivity is used to access the higher frequency range.

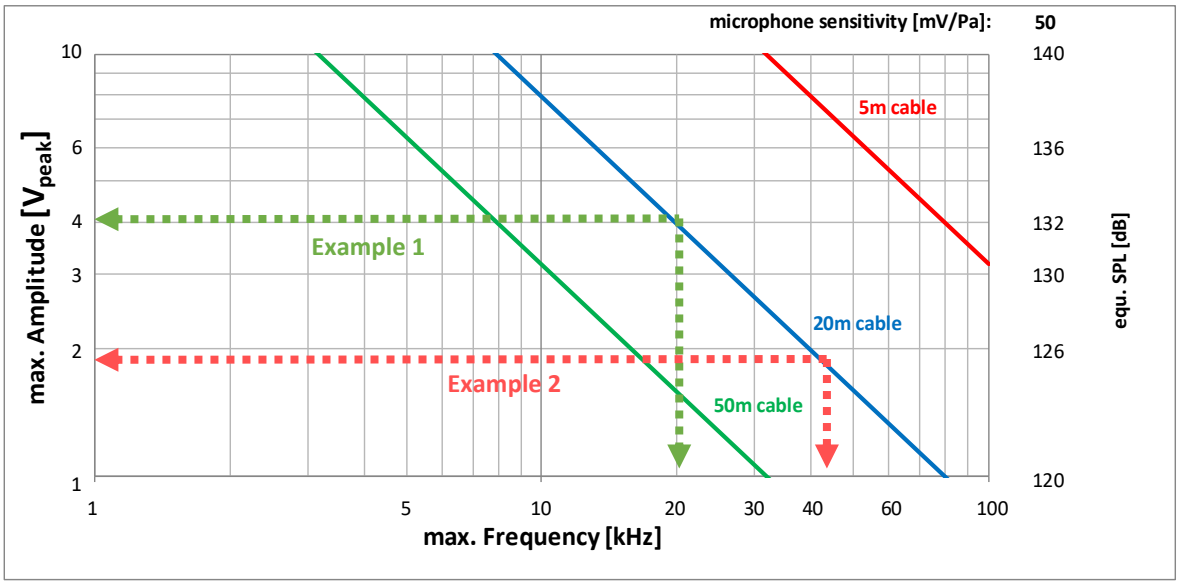
According to the plot, the maximum peak amplitude is well above 6 V.

To get a more accurate value, calculation can be done using the equation above:

$$A_{\text{peak}}[\text{V}] = \frac{5.3\ [\text{mA}] * 1\text{e}^6}{100\left[\frac{\text{pF}}{\text{m}}\right] * 2 * \pi * 20[\text{m}] * 66[\text{kHz}]} = 6.4\text{V}_{\text{peak}}$$

That amplitude equals about 158 dB SPL for 4 mV/Pa microphone sensitivity, which is beyond the microphone limit of 155dB.

7.3 Limitations for PA/DA devices (IEPE)



Example 1:

Operating the PA2 BNC microphone input with a common 50 mV/Pa microphone at 20 kHz maximum frequency and 20 m BNC cable.

According to the plot, the peak amplitude is approximately 4 V_{peak}.

To get a more accurate value, calculation can be done using the equation above:

$$A_{\text{peak}}[\text{V}] = \frac{1\ [\text{mA}] * 1\text{e}^6}{100\left[\frac{\text{pF}}{\text{m}}\right] * 2 * \pi * 20[\text{m}] * 20[\text{kHz}]} = 4\ \text{V}_{\text{peak}}$$

That amplitude equals 132 dB SPL for 50 mV/Pa microphone sensitivity, which is close to the microphone limit of 135dB. Reducing the cable length to 10 m would double the maximum amplitude, hence increasing the maximum SPL by 6 dB to 138 dB.

Example 2:

Operating the DA BNC microphone input with a microphone of just 4 mV/Pa sensitivity at a maximum frequency of 44 kHz using a 20 m cable. Microphone of less sensitivity is used to access the higher frequency range.

According to the plot, the maximum peak amplitude is a little below 2 V.

To get a more accurate value, calculation can be done using the equation above:

$$A_{\text{peak}}[\text{V}] = \frac{1\ [\text{mA}] * 1\text{e}^6}{100\left[\frac{\text{pF}}{\text{m}}\right] * 2 * \pi * 20[\text{m}] * 44[\text{kHz}]} = 1.8\ \text{V}_{\text{peak}}$$

That amplitude equals about 147 dB SPL for 4 mV/Pa microphone sensitivity, which is close to the microphone limit of 155dB.

7.4 Phantom Powered Microphones

Phantom powered microphones do suffer from the same effect as IEPE powered devices. The cable capacitance is slightly higher at 120 pF/m. Unfortunately, the operating conditions are less known in terms of supplied current from the 48 V power source. Additionally, the transition between regular operation and clipping is softer.

When using phantom powered microphones, the cable length values given in *Limitations for KA3 devices (IEPE)* **split in half** are a good rule of thumb. Please note that attenuation and distortion at high frequencies can already appear with shorter cables. They are a good indicator to check microphone limitations due to cable capacitance.

8 Accessories

8.1 Microphone Calibrator

(Sound Pressure Calibrator)

Article Number: 2400-023

FEATURES	• Provides easy and fast calibration of microphones • Two calibration frequencies and levels • Compatible to 1", ½", ¼" and ⅛" microphones • Portable (two type LR03 alkaline batteries (AAA-size) operated)	
COMPONENTS	• Adapter for ½", ¼" and ⅛" microphones (*8) • Compatible with all capsules provided by Klippel (*9)	
GRAS 42AG	**Multifunction Sound Calibrator, Class 1** • Supported by Klippel QC and R&D software • Calibration at two different frequencies: 250 Hz or 1 kHz • Calibration at two different levels: 94 dB or 114 dB • Measurement of ambient air pressure, temperature and humidity • Automatic compensation and Display of environmental conditions • Green LED lights when calibration level is OK • Automatic switch off after 10 to 20 s • Automatic shut off when batteries are too low • Calibrating at 250Hz is recommended for ½" and larger cartridges. The pressure stasis could cause small deviation at higher frequencies	
	Standards	IEC 60942 (2003) ANSI/ASA S1.40 (2006)
	Sound pressure level (re: 20 µPa) (*10)	94 (±0.2 dB) or 114 (± 0.2 dB)
	Frequency (*7)	250 (251.19 ± 0.30 Hz) or 1 kHz (1000 ± 1 Hz)
	Distortion	< 2.0 %
	Sensitivity to environmental conditions	IEC 60942 Class 1
	Microphone size	1", 1/2", 1/4", 1/8"
	Display of temperature, air pressure and humidity	
	Temperature	- 10 °C to + 50 °C; accuracy ± 2 °C, resolution 0.1 °C
	Atmospheric pressure	65 kPa to 108 kPa; accuracy ± 0.4 kPa, resolution 0.1 kPa
	Relative Humidity	25% to 90%, accuracy ±6%, resolution 1%
	Battery type	Two 1.5V LR03/AAA Size alkaline cells
	Display	Monochrome OLED with 128 x 64 resolution
	Weight	124 g

8.2 Microphone IEPE Power Supply

Item number: 2400-052

The IEPE power supply G.R.A.S. 12AL is required for operation with older Distortion Analyzer units (version 1.x), which do not have built in IEPE power supply. For connectivity to the DA Line input a BNC output cable and BNC to XLR adapter is included.

GRAS 12AL

- Recommended for RnD System
- 1-Channel
- BNC Input and Output
- Switchable A-weighting network
- Battery or externally powered
- Battery status LED
- Overload indicator LED

Including:

- AC main power supply
- 1 m BNC-BNC cable
- BNC to XLR male adapter

IEPE Voltage / Current	+28 V / 4 mA
Input Impedance	> 100 kΩ
Output Impedance without A-weighting	as source in serial with 22 µF
Output Impedance with A-weighting	100 Ω in serial with 22 µF
Frequency range (-3 dB) @ 10 kΩ signal output	0,7 Hz - 200 kHz
A-weighting network according	IEC 60651 Type 0
Signal Gain	0 dB
DC supply voltage / current	3 - 6 V / 50 – 120 mA
AC main power supply	100 ...240 V
In- / Output Connectors	BNC
Dimensions (W x H x D) / weight	66 x 28 x 91 mm / 110 g (160g with battery)
Case	Aluminum cabinet
Temperature (operation)	-10 ... +50 °C

IEPE supply units with more channels are on request.

Item number: 2400-301

The IEPE power supply IV11-S may be used to connect IEPE microphones to the line inputs of the QC Production Analyzer hardware. With its switchable 0 and +10 dB gain it offers the same features as Production Analyzer's BNC inputs with included IEPE supply.
For connectivity to the Production Analyzer's Line input, a BNC output cable and BNC to XLR adapter is included.

IV 11-S	• Recommended for Production Analyzer • 1-Channel • BNC In and Out • Switchable gain stage • Mini USB power socket • Overload indicator LED Including: • AC main power supply • 1 m BNC-BNC cable • BNC to XLR male adapter	
	IEPE Voltage	+24 V / 4 mA
	Input Impedance	1 MΩ
	Output Impedance	50 Ω
	Frequency range (-3 dB)	0,2 Hz - 100 kHz
	Signal Gain	0 or 10 dB
	DC supply	5 V
	AC main power supply	100 ...240 V
	In- / Output Connectors	BNC
	Dimensions (W x H x D)	100 x 55 x 24 mm
	Case	Aluminum cabinet
	Temperature (operation)	-10 ... +50 °C
	Temperature (storage)	-25 ... +70 °C

Item number: 2400-097

The IEPE power supply G.R.A.S. 12BA enables TEDS data integration into the KLIPPEL ANALYZER SYSTEM. The TEDS data may be USB interfaced by a command line tool.
For connectivity to the KA3, PA, DA Line inputs a BNC output cable and BNC to XLR adapter is included.

GRAS 12BA	• 1-Channel • BNC Input and Output • USB powered • Channel display for TEDS info Including: • USB C – USB 2.0 cable • 1 m BNC-BNC cable • BNC to XLR male adapter	
	IEPE Voltage / Current	+28 V / 4 mA
	Frequency range (+/- 0.03 dB @ Z_{source} <= 50 ohm, Z_{sink} >= 100 kOhm)	20 Hz - 200 kHz
	Signal Gain	0 dB
	DC supply voltage / current	5 V / max. 500 mA via USB
	Dimensions (W x H x D) / weight	108 x 44.2 x 193.8 mm / 397 g
	Temperature (operation)	0 ... +45 °C

8.3 Mic Clamps

		Item number: 2400-222
Mic clamp for mounting ¼” microphones at a fixed 90° position at various accessories		
AL0029	• ¼” clamping width • ¼” UNC mounting thread • (swivel range by additional ball joint) • Included in: Mic 46BE IEPE ¼” Set	

		Item number: 2400-224
Mic clamp for mounting 7 mm microphones at a fixed 90° position at various accessories		
AL0028	• 7 mm clamping width • ¼” UNC mounting thread • (swivel range by additional ball joint) • Included in: Mic 40PP-10 IEPE ¼“ Set Mic 40PP-10-S1 IEPE ¼“ Set	

		Item number: 2400-221
Mic clamp for mounting ¼” and ½” microphones with a > 180° swivel range at various accessories		
MH64.2	• ½” clamping width • ¼” clamping width with adapter • 5/8” UNC mounting thread • 3/8” UNC mounting thread with included adapter • > 180° swivel range, lockable • Included in: Mic 301E IEPE ¼” Set	

		Item number: 2400-204
Mic clamp for mounting ½” microphones with a > 180° swivel range at various accessories		
MH64	• ½” clamping width • 5/8” UNC mounting thread • 3/8” UNC mounting thread with included adapter • > 180° swivel range, lockable • Included in: Mic 255 IEPE ½” Set Mic 212 IEPE ½” Set Mic 255 48V ½” Set Mic 202E IEPE ½” Set Mic 301E 48V ½” Set	

		Item number: 2400-206
Mic clamp for mounting ½” microphones at a fixed 90° position at various accessories		
MK10	• ½” clamping width • ¼” UNC mounting thread • (swivel range by additional ball joint) • Included in: Mic 46AE IEPE ½“ Set Mic 146AE IEPE ½“ Set Mic 46AM IEPE ½“ Set	

		Item number: 2400-225
Mic clamp for mounting 22 mm microphones with a > 180° swivel range at various accessories		
MH22	• 22 mm clamping width • 5/8” UNC mounting thread • 3/8” UNC mounting thread with included adapter • > 180° swivel range, lockable • Included in: Mic 221 48V ½” Set Mic 202 48V ½” Set Mic 301 48V ½” Set	

8.4 Wind Screens & Protectors

Foam pieces to reduce wind noise and to protect mic capsules and complete mics from damages.

• Round ¼" foam wind screen • Ø = 30 mm	• Cylindrical ½" foam protector • Whole mic covered • Ø = 35 mm x 160 mm	• Round ½" foam wind screen • Ø = 80 mm
Item number: 2400-207	Item number: 2400-008	Item number: 2400-209

8.5 Adapters

Item number: 2300-102

XLR male to BNC female adapter

- Connect IEPE powered mics with standard BNC connector to Phantom powered input channels with XLR connector.
- Between mic and adapter a standard BNC male to BNC male cable, included in the mic sets need to be used.
  - Pinout according IEC 268-12:
- Signal: BNC center pin = XLR 2 (hot signal)
  - GND: BNC shield = XLR 1 & 3 (GND & cold)
- Shorts the negative side of the 48V supply!
  - Verified with Klippel Analyzer 3 – KA3 and Klippel offered IEPE powered mics.
- Could also be used to connect the KA3 Laser card BNC output with a XLR input of an amplifier.

Item number: 2400-212

Connect SMB mics with standard BNC cables. Adapter or BNC plug could be clamped with MK10 mic clamp.

8.6 3/8” Gooseneck

Item number: 2400-223

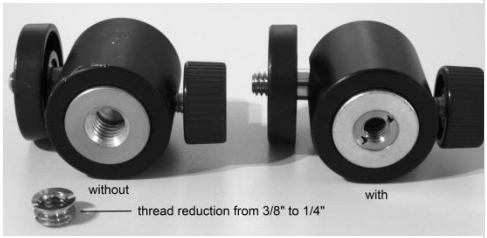
- Flexible but solid 20 cm Gooseneck with 3/8” UNC inner and outer thread
- Included 3/8” UNC outer thread to 3/8” UNC outer thread adapter
- Included 3/8” UNC outer thread to 1/4” UNC outer thread adapter
- For mounting mics at the Klippel Microspeaker Clamping or Multi-Scanning Workbench
- Included in Klippel Micro-speaker Clamping platform, accessory for the Multi-Scanning Workbench

8.7 Swivel Head / Ball Joint

Item number: 2400-216

For unrestricted but solidly fixed microphone positioning.
Can be used to mount any microphone to a microphone or laser stand and combined with any mic clamp.

- Unrestricted movable head
- Solid clamping
- Mic connection: 1/4” UNC thread (or 3/8” with included adapter)
- Stand connection: 3/8” UNC thread (or 1/4” with included adapter)
- Included in:
  Klippel Pro Stand
  Klippel Microspeaker Clamping



8.8 NFS Microphone Collision Sensor

Item number: 2520-024

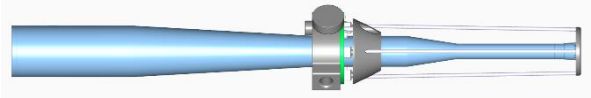
- Microphone Collision Sensor for NFS – Near Field Scanner
- Safety switching contact to stop the aperture in case of an emergency
- May be mounted to ½”- and ¼”-mics
- Offers an additional ¼” UNC inner thread for mounting
- Acoustical transparent design for minimal acoustical influence

Mic-Collision-Sensor rev. 0.3

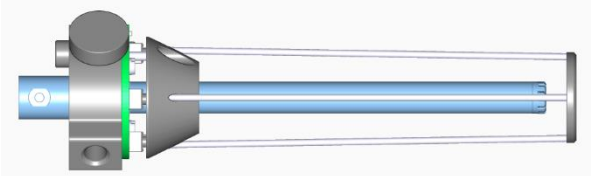
- Overall length: 111 mm

<u>Recommended for:</u>

- Mic 301E 48V ¼” Set
- Mic 301 48V ¼” Set

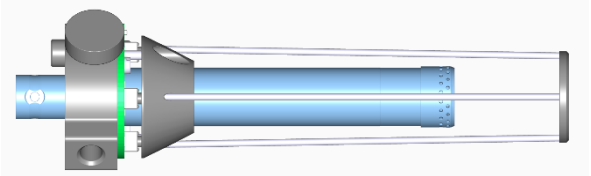


- Mic 40PP-10 IEPE ¼” Set



<u>Applicable for (not for Baffle Add-On):</u>

- Mic 255 IEPE ½” Set



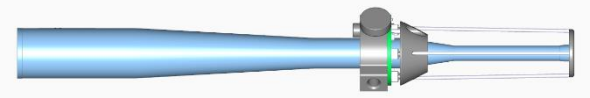
- Mic 255 48V ½” Set

Mic-Collision-Sensor rev. 1.0

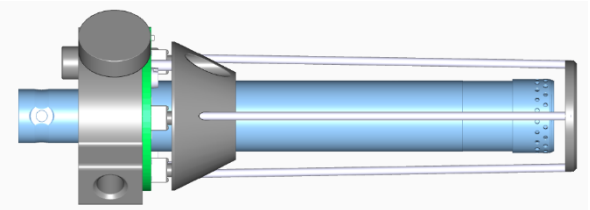
- Overall length: 90 mm

<u>Recommended for:</u>

- Mic 301E 48V ¼” Set
- Mic 301 48V ¼” Set



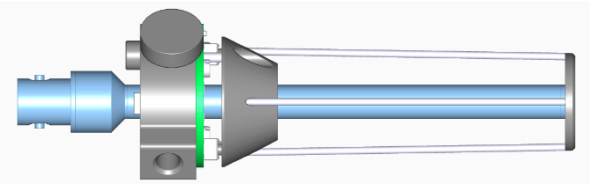
- Mic 255 IEPE ½” Set



- Mic 255 48V ½” Set

<u>Applicable for:</u>

- Mic 40PP-10 IEPE ¼” Set



8.9 Hints for Accessory Selection

- 1/4” (20 TPI) UNC thread: has an approximately outer Ø of 6.3 mm / inner Ø of 5.4 mm
- 3/8” (16 TPI) UNC thread: has an approximately outer Ø of 9.3 mm / inner Ø of 8.3 mm
- 5/8” (11 TPI) UNC thread: has an approximately outer Ø of 15.5 mm / inner Ø of 15 mm

  (TPI = threads per inch)
- Klippel microphone sets having clamps with 1/4” or 3/8” or 5/8” threads. All have thread adapters included for supporting at least 1/4” and 3/8” mounting threads.
- Klippel accessories such as Pro Driver Stand, Micro Speaker Clamping, and Near Field Scanner support 1/4” and 3/8” threads.
- ¼” measurement microphones have a pre-amplifier diameter of 6.35 mm (1/4”) and a cartridge protection grid diameter of 7 mm. The cartridge diameter will be a little less than ¼”.
- 7 mm QC or array microphones have a pre-amplifier diameter of 7 mm and also a cartridge protection grid diameter of 7 mm. The cartridge diameter will be a little less than ¼”.
- ¼” measurement microphones and 7 mm QC and array microphones are both using the same ¼” calibration adapter but different mic clamps.
- ½” measurement microphones have a pre-amplifier diameter of 12.7 mm (1/2”) and a cartridge grid diameter of 13.2 mm. The cartridge diameter will be a little less than ½”.

9 Notes

- (*1) Peak value considering the maximum positive deviation of the sensitivity. Depending on the specific sensitivity, the value could be higher.
- (*2) Peak value considering the maximum positive deviation of the sensitivity. Depending on the specific sensitivity, the value could be higher. Values lower than max. SPL level @ KA3 (Klippel Analyzer 3) / DA (Distortion Analyzer) are determined by default PA (Production Analyzer) input gain stage of +10dB.

  Note that the PA input gain stage can easily be changed to 0 dB. In this case the max SPL values are identical to the max. SPL level @ KA3 / DA in the line above.
- (*3) Nominal sensitivity for the particulate mic type at reference ambient conditions
  (typically: 23°C / 50 % / 101 kPA). Same cartridge combined with a different pre-amplifier could result in different nominal sensitivity for the cartridge and pre-amplifier combination caused by different pre-amplifier damping values.
- (*4) Sensitivity series spread is the manufacturer's allowed variation from each specimen to the nominal sensitivity at reference ambient conditions.
- (*5) Within the resulting sensitivity range, each specimen from the particular mic type should have its sensitivity at reference ambient conditions.
  For typical sensitivity variation due to ambient condition changes, see chapter *6.2 Ambient Condition*
- (*6) Noise level in dB(A) specified by manufacture with related preamplifier.
- (*7) Polarity of cartridge and preamp combination: (+) sound pressure = (+) voltage = 0°
- (*8) The ¼” adapter, along with this calibrator, is not for Mic Sets MI17 / MI17HL and MI18 / MI18HL
- (*9) Adapter ¼” Nor4589 (Article Number: 2400-024) is needed for Mic Sets MI17 / MI17HL and MI18 / MI18HL
- (*10) Levels and frequencies at reference conditions (23.0°C / 101.325 kPa / 50% Relative Humidity)
- (*11) Note the hints at chapter 5 regarding the influence of the protection grid
- (*12) Measurement microphone designation according IEC 61094-4: WS = Working Standard, 1 = 1”, 2 = ½”, 3 = ¼”, F = Free Field, P = Pressure Field
- (*13) Correction Curve: The microphones frequency response curve in a digital format is included, may be used as correction curve in the measurement software.

10 Obsolete or Replaced - Free Field - Measurement Microphones

	Sensitivity in mV/Pa	Max. SPL before clipping in dB	Noise level (*3) in dB(A)	Frequency range in Hz	
Mic 250 IEPE ½" Set *replaced by* *Mic 255 IEPE ½" Set*	50	135	15	3.5 – 20k	
	• Comparable specification to replacing mic • different capsule material • higher price than replacing mic • Mic 250 IEPE ½" Set is still available on request • Item number: 2400-002				
Mic 255 48V ½" Set *replaced by* *Mic 301E 48V ¼" Set*	41.6	135	15	3.5 – 20k	
	• pre-polarized cartridge, fixed mounted XLR cable • Replaced with ¼" mic of similar type for lower angle dependency, relevant for NFS application • Polarity: 180° <= SN #1000 / 0° >= SN #1001 • Mic 255 48V ½" Set is still available on request • Item number: 2400-015				
Mic 255.S 48V ½" Set *replaced by* *Mic 221 48V ½" Set*	50	135	15	3.5 – 20k	
	• Comparable specification to replacing mic • pre-polarized cartridge, replaced with 200V polarized cartridge • same price as replacing mic • Mic 255.S 48V ½" Set is still available on request • Item number: 2400-601				
Mic 40PP IEPE ¼" Set *replaced by* *Mic 40PP-10 IEPE ¼" Set*	50	129	33	10 – 20k	
	• Comparable specification to replacing mic • Discontinued and replaced by manufacturer				
Mic 40PH IEPE ¼" Set *replaced by* *Mic 40PP-10 IEPE ¼" Set*	50	129	33	10 – 20k	
	• Comparable specification to replacing mic • Discontinued and replaced by manufacturer • Replaced by Klippel by more robust equivalent with BNC connector				
Mic 40PH-10 IEPE ¼" Set *replaced by* *Mic 40PP-10 IEPE ¼" Set*	50	129	33	10 – 20k	
	• Comparable specification to replacing mic • Replaced by Klippel by more robust equivalent with BNC connector • Mic 40PH-10 IEPE ¼" Set is still available on request				
Mic 17 IEPE ¼" Set & Mic 18 IEPE ¼" Set *replaced by* *Mic 40PP-10 IEPE ¼" Set*	50	126	30	30 – 20k	
	• Better performance of replacing mic • With its unstandardized diameter of 8 mm it can only be clamped with ½" clamps by using the dedicated black plastic adapter. • Discontinued and replaced by manufacturer • Replaced by Klippel by cost-effective QC microphone				

	Sensitivity in mV/Pa	Max. SPL before clipping in dB	Noise level (*3) in dB(A)	Frequency range in Hz	
Mic 202E IEPE ½" Set *replaced by* *Mic 211E IEPE ½" Set*	12	145	22	3.15 – 40 k	
	• Cartridge replaced by manufacturer (MK202E → MK211E) • Comparable specification				
Mic 202 48V ½" Set *replaced by* *Mic 211 48V ½" Set*	12	145	22	10 – 40 k	
	• Cartridge replaced by manufacturer (MK202 → MK211) • Comparable specification				
Mic 202E 48V ½" Set *replaced by* *Mic 202 48V ½" Set*	14	143	22	3.15 – 40 k	
	• Replaced by Klippel by more robust mic with removable cable • pre-polarized cartridge, replaced with 200V polarized cartridge • Mic 202E 48V ½" Set is still available on request				
Mic 202E.S 48V ½" Set *replaced by* *Mic 202 48V ½" Set*	14	143	22	3.15 – 40 k	
	• pre-polarized cartridge, replaced with 200V polarized cartridge • higher price than replacing mic • Mic 202E.S 48V ½" Set is still available on request				
Mic 40PP-S1 ¼" Set *replaced by* *Mic 40PP-10-S1 IEPE ¼" Set*	10	142	33	10 – 20 k	
	• Comparable specification to replacing mic • Discontinued and replaced by manufacturer				
Mic 40PL ¼" Set *replaced by* *Mic 40PP-10-S1 IEPE ¼" Set*	10	142	33	10 – 20 k	
	• Comparable specification to replacing mic • Discontinued and replaced by manufacturer • Replaced by Klippel by more robust equivalent with BNC connector				
Mic 40PL-10 ¼" Set *replaced by* *Mic 40PP-10-S1 IEPE ¼" Set*	10	142	33	10 – 20 k	
	• Comparable specification to replacing mic • Replaced by Klippel by more robust equivalent with BNC connector • Mic 40PL-10 IEPE ¼" Set is still available on request				
Mic 17-HL IEPE ¼" Set *replaced by* *Mic 40PP-10-S1 IEPE ¼" Set*	10	138	44	30 – 20 k	
	• Polarity = 180° • Better performance of replacing mic • With its unstandardized diameter of 8 mm it can only be clamped with ½" clamps by using the dedicated black plastic adapter. • Discontinued and replaced by manufacturer • Replaced by Klippel by cost-effective QC microphone				
Mic 18-HL IEPE ¼" Set *replaced by* *Mic 40PP-10-S1 IEPE ¼" Set*	10	143	44	30 – 20 k	
	• Polarity = 0° • Better performance of replacing mic • With its unstandardized diameter of 8 mm it can only be clamped with ½" clamps by using the dedicated black plastic adapter. • Discontinued and replaced by manufacturer • Replaced by Klippel by cost-effective QC microphone				

	Sensitivity in mV/Pa	Max. SPL before clipping in dB	Noise level (*3) in dB(A)	Frequency range in Hz	
Mic 301E.S 48V ¼" Set *replaced by* *Mic 301 48V ¼" Set*	3.2	155	36	5 – 100 k	
	• pre-polarized cartridge, replaced with 200V polarized cartridge • higher price than replacing mic • Mic 301E.S 48V ½" Set is still available on request				
Mic 46BE-S5 IEPE ¼" Set *replaced by* *Mic 46BE IEPE ¼" Set*	4	154	35	4 – 100 k	
	• Special type with SMB connector replaced with default type with Microdot connector				
	22	132	20	3 – 20k	
Mic 7052H IEPE ½" Set *replaced by* *Mic 255 IEPE ½" Set*	• Better performance of replacing mic • Replaced by Klippel due to long-term stability issues				

Klippel GmbH reserves the right to change specifications without notice.

Find explanations for symbols at:
http://www.klippel.de/know-how/literature.html
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