Tips on how to choose a suitable amplifier for your beloved headphone

By one way or another, we have been acknowledged that many users are haunted with one question: which FiiO amplifier would go perfectly with one certain headphone or earplug.

Generally speaking, we should take the timbre and the power into consideration when speaking of the match of amplifier with headphone. As is known to us all, the match of timbre is kind of complicated. For those who possess headphone in somewhat "cold sound", all he needs is a "warm sound" amplifier to balance it out. Due to the subjectivity of timbre, it can't be quantized or described with specific numeral data which then results in" Each one thinks in his way." Therefore, here we may mainly focus on the explanation on the matching from the aspect of the power.

First of all, we should have a clear definition here. In term of the sound reduction merely, different people would have different expectations of the sound according to different using environment, personalized listening curve and individualized loved music type. Therefore, we need to do a simple classification regarding the headphone sound.

A. Standard sound pressure (95dB):

Under normal application environment, we define the sound pressure of the headphone as standard level when enjoying popular music. Considering the theoretic dynamic range of CD being 96dB, whereas the minimum sound pressure that human ear can hear out of 1 KHz is 0 dB, then the dynamic range for the maximum sound pressure of 95dB is 95dB as well. As a result, we define the maximum sound pressure of 95dB as the basic needs of enjoying common music.

B. Favorable sound pressure (105dB):

As a matter of fact, 95dB sound pressure is far from satisfactory in enjoying high quality music. Normally speaking, in terms of the live show of symphonic music, rock concert and other sort of high dynamic music forms, the maximum sound pressure can reach 105dB. Therefore, we define 105dB sound pressure as favorable sound pressure.

C. Excellent sound pressure (120dB):

105dB sound pressure, is it enough? In reality, the sound of the nature is far above 105dB, like the sound of the thunderstorm, the sound felt towards a plane flying nearby whose maximum sound would hit above 120dB. Also, the record of SACD format music can reach 120dB as well. That's why we regard 120dB as excellent sound pressure.

With the help of this quantized sound pressure levels, we can calculate how much power it needs to boost one specific headphone according to the theoretical computational formula.

The procedure and formula of the calculation are as follows:

1. Usually, each headphone would be given with one sensitivity data which is tested under the environment of below 1mW power.
2. Based on the required sound pressure, work out the corresponding power (P for short).
Assuming the maximum required sound pressure as B, and A as the rated sensitivity of the headphone, then the computational formula would be P=10^ ((B-A)/10).
3. In line with the power requirements, figure out the required maximum voltage and current.

The reason why we should calculate the maximum voltage and current is because P=I (current) *U (voltage) .
As to the fixed output power of one certain amplifier, it may thanks to the high output voltage or because of the high output current.

Take the Beyerdynamic DT990 for example, while in different headphone impedance with one version at 32Ohm and one at 250Ohm, in order to get 120dB sound pressure, they both require for 251.19mW power due to the same sensitivity. However, the required maximum current of the 32Ohm version is 88.60mA which is far above the 31.70mA of the version with 250Ohm.

To the contrary, the demanded amplitude peak in boosting the voltage of the DT990 with 250Omh impedance would be 22.41V which is far above the 8.02V of the version with 32Ohm. This tells us that power rate is not the only thing we should consider. To a headphone with low impedance, high current and low voltage is what it requires, while high voltage and low current would be the target of headphone at high impedance. That’ s why we need to work out the corresponding output voltage and current in order to select suitable amplifier.

One more thing we need to be aware of is that the impedance and the sensitivity of the headphone is not a fixed figure which might vary with the headphone input signal’ s response. Generally speaking, the maximum impedance of the headphone is higher than the rated one, which even can be 3 folds higher. So does the minimum impedance and the rated one. Thus, the data result from the formula should be regarded as a merely reference.

To sum up, in accordance with corresponding power and high dynamic peak voltage required by 120dB sound pressure and the current demanded by high dynamic, the chosen amplifier would basically meet some kind of high level of sound effect. If take the power storage into consideration, we can also get it doubled or tripled based on the related power of 120dB.

You can feel free to visit our official website at www.fiio.net to get the related information about the maximum output power, peak voltage of high dynamic and the current of high dynamic in terms of all the amplifiers and amplifiers with decode function. You are warmly welcome to select the suitable amplifier to your own headphone based on the listed information.

Based on this formula, we have worked out the power, voltage and current for some popular headphones.
In order to get the best sound effect, you can refer to the power required by 120dB sound pressure and peak voltage required by high dynamic.

Brand \ Unit	Model	Impedance	Sensitivity	Power required by 95dB sound pressure	Power required by 105dB sound pressure	Power required by 120dB sound pressure	Peak voltage required by high dynamic	Current required by high dynamic
		Omh	dB/mW	mW	mW	mW	Vp-p	mA
KOSS	A250	60	98	0.50	5.01	158.49	8.72	51.40
	PP	60	118	0.25	2.51	79.43	6.17	36.39
	KSC35	60	101	0.25	2.51	79.43	6.17	36.39
audio-technica	ATH-A1000	40	103	0.16	1.58	50.12	4.00	35.40
	ATH-A700	64	102	0.20	2.00	63.10	5.68	31.40
	ATH-A900	40	101	0.25	2.51	79.43	5.04	44.56
	ATH-AD700	32	98	0.50	5.01	158.49	6.37	70.38
	ATH-A2000X	42	101	0.25	2.51	79.43	5.17	43.49
	ATH-CM7	16	100	0.32	3.16	100.00	3.58	79.06
	ATH-EM7	32	109	0.04	0.40	12.59	1.79	19.83
	ATH-EW9	29	105	0.10	1.00	31.62	2.71	33.02
	ATH-L3000	48	104	0.13	1.26	39.81	3.91	28.80
	ATH-W100	48	100	0.32	3.16	100.00	6.20	45.64
	ATH-W1000	40	101	0.25	2.51	79.43	5.04	44.56
	ATH-ON300	32	102	0.20	2.00	63.10	4.02	44.40
	CK100		113	0.02	0.16	5.01	0.00	#DIV/0!
beyerdynamic	DT231	32	96	0.79	7.94	251.19	8.02	88.60
	DTX501p	32	104	0.13	1.26	39.81	3.19	35.27
	DT860	32	97	0.63	6.31	199.53	7.15	78.96
	DT880	250	96	0.79	7.94	251.19	22.41	31.70
	DT990	32	96	0.79	7.94	251.19	8.02	88.60
	DT990	250	96	0.79	7.94	251.19	22.41	31.70

Brand \ Unit	Model	Impedance	Sensitivity	Power required by 95dB sound pressure	Power required by 105dB sound pressure	Power required by 120dB sound pressure	Peak voltage required by high dynamic	Current required by high dynamic
beyerdynamic	DTX800	32	105	0.10	1.00	31.62	2.84	31.44
	DTX900	32	108	0.05	0.50	15.85	2.01	22.25
	DT1350	80	109	0.04	0.40	12.59	2.84	12.54
	T1	600	102	0.20	2.00	63.10	17.40	10.25
	T70	250	104	0.13	1.26	39.81	8.92	12.62
	MMX100	12	102	0.20	2.00	63.10	2.46	72.51
SHURE	E2C	16	105	0.10	1.00	31.62	2.01	44.46
	E3C	26	115	0.01	0.10	3.16	0.81	11.03
	E4C	29	109	0.04	0.40	12.59	1.71	20.84
	E5C	110	122	0.00	0.02	0.63	0.75	2.39
	SE530	36	119	0.00	0.04	1.26	0.60	5.91
	SE535	36	119	0.00	0.04	1.26	0.60	5.91
	SE215	20	107	0.06	0.63	19.95	1.79	31.59
	SE215	20	107	0.06	0.63	19.95	1.79	31.59
	SE315	27	116	0.01	0.08	2.51	0.74	9.65
	SRH940	42	100	0.32	3.16	100.00	5.80	48.80
	SRH840	44	102	0.20	2.00	63.10	4.71	37.87
	SRH44	44	105	0.10	1.00	31.62	3.34	26.81
	SRH240	38	105	0.10	1.00	31.62	3.10	28.85
	SRH750DJ	32	106	0.08	0.79	25.12	2.54	28.02
	SRH1840	65	96	0.79	7.94	251.19	11.43	62.16
	SRH1440	37	101	0.25	2.51	79.43	4.85	46.33
	SE115	16	105	0.10	1.00	31.62	2.01	44.46

Unit / Brand	Model	Impedance	Sensitivity	Power required by 95dB sound pressure	Power required by 105dB sound pressure	Power required by 120dB sound pressure	Peak voltage required by high dynamic	Current required by high dynamic
		Omh	dB/mW	mW	mW	mW	Vp-p	mA
SONY	MDR-E888LP	16	108	0.05	0.50	15.85	1.42	31.47
	MDR-EX1000	32	108	0.05	0.50	15.85	2.01	22.25
	MDR-EX600	32	107	0.06	0.63	19.95	2.26	24.97
	MDR-EX310SL	16	105	0.10	1.00	31.62	2.01	44.46
	MDR-EX210B	16	104	0.13	1.26	39.81	2.26	49.88
	R10	40	100	0.32	3.16	100.00	5.66	50.00
	XBA-10	24	102	0.20	2.00	63.10	3.48	51.27
	XBA-20	48	102	0.20	2.00	63.10	4.92	36.26
	XBA-30	48	102	0.20	2.00	63.10	4.92	36.26
	XBA-40	16	102	0.20	2.00	63.10	2.84	62.80
	MDR-1R	24	105	0.10	1.00	31.62	2.46	36.30
	MDR-XB200	24	100	0.32	3.16	100.00	4.38	64.55
	MDR-XB30EX	16	105	0.10	1.00	31.62	2.01	44.46
	MDR-XB900	24	106	0.08	0.79	25.12	2.20	32.35
	MDR-XB90EX	16	106	0.08	0.79	25.12	1.79	39.62
	MDR-XB60EX	16	105	0.10	1.00	31.62	2.01	44.46
	MDR-XB600	40	104	0.13	1.26	39.81	3.57	31.55
	MDR-XB1000	24	106	0.08	0.79	25.12	2.20	32.35
	MDR-XB41EX	16	105	0.10	1.00	31.62	2.01	44.46
	MDR-XB21EX	16	103	0.16	1.58	50.12	2.53	55.97
ER4 microPro earphones	ER4P	37	102	0.20	2.00	63.10	4.32	41.30
	ER4B	100	108	0.05	0.50	15.85	3.56	12.59
	ER6	48	108	0.05	0.50	15.85	2.47	18.17

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		Omh	dB/mW	mW	mW	mW	Vp-p	mA
ER4 microPro earphones	ER6i	16	108	0.05	0.50	15.85	1.42	31.47
SENNHEISER	HD200	64	106	0.08	0.79	25.12	3.59	19.81
	HD201	24	108	0.05	0.50	15.85	1.74	25.70
	HD202	32	115	0.01	0.10	3.16	0.90	9.94
	HD212pro	32	112	0.02	0.20	6.31	1.27	14.04
	HD215	32	109	0.04	0.40	12.59	1.79	19.83
	HD25SP	85	109	0.04	0.40	12.59	2.93	12.17
	HD270	64	106	0.08	0.79	25.12	3.59	19.81
	HD280pro	64	113	0.02	0.16	5.01	1.60	8.85
	HD437	32	115	0.01	0.10	3.16	0.90	9.94
	HD457	32	114	0.01	0.13	3.98	1.01	11.15
	HD465	32	110	0.03	0.32	10.00	1.60	17.68
	HD477	32	109	0.04	0.40	12.59	1.79	19.83
	HD485	32	110	0.03	0.32	10.00	1.60	17.68
	HD497	32	112	0.02	0.20	6.31	1.27	14.04
	HD500	32	105	0.10	1.00	31.62	2.84	31.44
	HD515	50	105	0.10	1.00	31.62	3.56	25.15
	HD555	50	112	0.02	0.20	6.31	1.59	11.23
	HD570	64	102	0.20	2.00	63.10	5.68	31.40
	HD580	300	97	0.63	6.31	199.53	21.88	25.79
	HD590	120	103	0.16	1.58	50.12	6.94	20.44
	HD595	120	112	0.02	0.20	6.31	2.46	7.25
	HD598	50	112	0.02	0.20	6.31	1.59	11.23

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		Omh	dB/mW	mW	mW	mW	Vp-p	mA
SENNHEISER	HD600	300	97	0.63	6.31	199.53	21.88	25.79
	HD650	300	98	0.50	5.01	158.49	19.50	22.98
	HD700	150	105	0.10	1.00	31.62	6.16	14.52
	HD800	300	102	0.20	2.00	63.10	12.30	14.50
	MX500	32	125	0.00	0.01	0.32	0.28	3.14
	MX550	16	123	0.00	0.02	0.50	0.25	5.60
	PX100	32	114	0.01	0.13	3.98	1.01	11.15
	PX200	32	100	0.32	3.16	100.00	5.06	55.90
	MX375	32	122	0.00	0.02	0.63	0.40	4.44
	MX760	32	114	0.01	0.13	3.98	1.01	11.15
	MX880	16	120	0.00	0.03	1.00	0.36	7.91
	MX980	16	120	0.00	0.03	1.00	0.36	7.91
	MX985	16	120	0.00	0.03	1.00	0.36	7.91
	MOMENTUM	18	110	0.03	0.32	10.00	1.20	23.57
	IE8	16	125	0.00	0.01	0.32	0.20	4.45
	IE80	16	125	0.00	0.01	0.32	0.20	4.45
	IE800	16	125	0.00	0.01	0.32	0.20	4.45
	IE6	16	115	0.01	0.10	3.16	0.64	14.06
	IE60	16	115	0.01	0.10	3.16	0.64	14.06
	CX980	32	115	0.01	0.10	3.16	0.90	9.94
AKG	K1000	120	74	125.89	1258.93	39810.72	195.47	575.98
	K141	55	101	0.25	2.51	79.43	5.91	38.00
	K141S	55	101	0.25	2.51	79.43	5.91	38.00

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		Omh	dB/mW	mW	mW	mW	Vp-p	mA
AKG	K171	55	94	1.26	12.59	398.11	13.23	85.08
	K240df	600	88	5.01	50.12	1584.89	87.21	51.40
	k240M	55	91	2.51	25.12	794.33	18.69	120.18
	k240S	55	91	2.51	25.12	794.33	18.69	120.18
	k24P	32	125	0.00	0.01	0.32	0.28	3.14
	k26P	32	125	0.00	0.01	0.32	0.28	3.14
	K271S	55	91	2.51	25.12	794.33	18.69	120.18
	K301	55	102	0.20	2.00	63.10	5.27	33.87
	K301XTRA	55	102	0.20	2.00	63.10	5.27	33.87
	K401	120	94	1.26	12.59	398.11	19.55	57.60
	K401	120	94	1.26	12.59	398.11	19.55	57.60
	K420	32	125	0.00	0.01	0.32	0.28	3.14
	K450	32	126	0.00	0.01	0.25	0.25	2.80
	Q460	32	125	0.00	0.01	0.32	0.28	3.14
	Q350	16	121	0.00	0.03	0.79	0.32	7.05
	K374	28	120	0.00	0.03	1.00	0.47	5.98
	K55	32	114	0.01	0.13	3.98	1.01	11.15
	K501	120	94	1.26	12.59	398.11	19.55	57.60
	K550	32	120	0.00	0.03	1.00	0.51	5.59
	K601	120	101	0.25	2.51	79.43	8.73	25.73
	K66	32	96	0.79	7.94	251.19	8.02	88.60
	K701	62	105	0.10	1.00	31.62	3.96	22.58
	K702	62	102	0.20	2.00	63.10	5.59	31.90

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		Omh	dB/mW	mW	mW	mW	Vp-p	mA
AKG	Q701	62	105	0.10	1.00	31.62	3.96	22.58
	K71	19	100	0.32	3.16	100.00	3.90	72.55
	K3003	8	125	0.00	0.01	0.32	0.14	6.29
AILISI	M1	32	100	0.32	3.16	100.00	5.06	55.90
GRADO	RS1	32	98	0.50	5.01	158.49	6.37	70.38
	SR325	32	98	0.50	5.01	158.49	6.37	70.38
	SR80	32	98	0.50	5.01	158.49	6.37	70.38
	SR125	32	98	0.50	5.01	158.49	6.37	70.38
	SR225	32	98	0.50	5.01	158.49	6.37	70.38
	ps500	32	98	0.50	5.01	158.49	6.37	70.38
	rs1i	96	98	0.50	5.01	158.49	11.03	40.63
	GR8	120	118	0.01	0.05	1.58	1.23	3.63
Astrotec	AS200HD	32	115	0.01	0.10	3.16	0.90	9.94
	ax7	32	108	0.05	0.50	15.85	2.01	22.25
	AM90	25	109	0.04	0.40	12.59	1.59	22.44
Logitech	UE 900	30	101	0.25	2.51	79.43	4.37	51.46
	TF10	32	117	0.01	0.06	2.00	0.71	7.90
	TF15	32	117	0.01	0.06	2.00	0.71	7.90
Edifier	H180	32	100	0.32	3.16	100.00	5.06	55.90
	K550	32	91	2.51	25.12	794.33	14.26	157.55
PHILIPS	Fidelio X1	30	100	0.32	3.16	100.00	4.90	57.74
DENON	AH-D1100	32	101	0.25	2.51	79.43	4.51	49.82
	AH-D7000	25	108	0.05	0.50	15.85	1.78	25.18

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		Omh	dB/mW	mW	mW	mW	Vp-p	mA
DENON	AH-D7100	24	110	0.03	0.32	10.00	1.39	20.41
stax	stax SR009	145	100	0.32	3.16	100.00	10.77	26.26
Westone THE IN-EAR EXPERTS	UM1	24	114	0.01	0.13	3.98	0.87	12.88
	UM2	27	119	0.00	0.04	1.26	0.52	6.83
	UM3	27	119	0.00	0.04	1.26	0.52	6.83
	W1	27	122	0.00	0.02	0.63	0.37	4.83
	W2	33	117	0.01	0.06	2.00	0.73	7.78
	W3	30	107	0.06	0.63	19.95	2.19	25.79
	W4R	31	118	0.01	0.05	1.58	0.63	7.15
Klipsch	X10	50	110	0.03	0.32	10.00	2.00	14.14
JVC	HA-FX700	16	104	0.13	1.26	39.81	2.26	49.88
	HA-S500	32	106	0.08	0.79	25.12	2.54	28.02
ECCI	PR200MKII	16	105	0.10	1.00	31.62	2.01	44.46
CREATIVE	Aurvana In-Ear2	42	110	0.03	0.32	10.00	1.83	15.43
	Aurvana In-Ear3	28	112	0.02	0.20	6.31	1.19	15.01