RC OSCILLATOR MODEL ORC11 INSTRUCTION MANUAL

INSTRUCTION MANUAL

RC OSCILLATOR
MODEL ORC11

KIKUSUI

KIKUSUI PART No. Z1-403-620, IA002112

The specifications of this product and the contents of this Instruction Manual are subject to change without prior notice.

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.
(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____A, _____VAC, and _____.

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

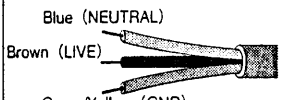
☐ AC power cable

The product is porvided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

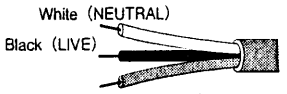
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

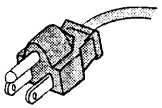
☐ Without a power plug



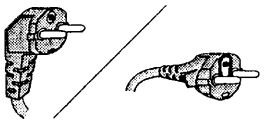
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

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1. GENERAL

The RC Oscillator (Model ORC11) is incorporated with the various advantageous features as follows:

(1) Wide frequency range (5 Hz - 500 kHz):
The oscillating frequency range is as wide as 5 Hz - 500 kHz. The frequency can be set with dial knobs of coarse/fine and push switches of 5-range.

(2) Low distortion (0.002%, 1 kHz typical):
The distortion factor of the sinusoidal wave signal within the range of 10 kHz - 20 kHz is not greater than 0.005%.

(3) Direct reading of output voltage:
The output voltage can be directly read. It can be delivered for a range of 0 dB (3.16 Vrms, output terminal open) to -79.9 dB in 0.1-dB steps quantitatively. The output voltage is stable with less temperature drift coefficient.

(4) Flat output frequency vs voltage characteristics:
The output frequency vs voltage characteristics is $\pm$0.2 dB or better for 5 Hz - 20 kHz.

(5) Sinusoidal wave or pulse wave:
Either a sinusoidal wave or a pulse wave of output can be selected with a slide switch. For either type of output, the output voltage can be preset with an attenuator and the waveform can be deflected with the zero volt line as the center of deflection.

(6) TTL OUT terminal provided:
A TTL OUT terminal is provided on the rear panel of the oscillator. This terminal constantly delivers a pulse wave of 0 to +5 V which is synchronized with the main output. This terminal can be directly used as a digital signal source. Even when a frequency counter is connected to this terminal for frequency monitoring or it is used otherwise, the distortion factor or other characteristics of the main output is not adversely affected.

2. SPECIFICATIONS

Power requirements:	90 - 110 V, 104 - 126 V, 194 - 236 V, 207 - 253 V, (selectable with plug on the rear panel). 50/60 Hz AC. Approx. 9 VA
Weight:	Approx. 3.5 kg
Dimensions:	134 W × 180 H × 250 D mm (5.28 W × 7.09 H × 9.84 D in.)
(Maximum dimensions):	140 W × 205 H × 300 D mm (5.51 W × 8.07 H × 11.81 D in.)
Ambient temperature:	5°C to 35°C (41°F to 95°F), 85% or less
Frequency ranges:	5 Hz - 500 kHz (in five ranges)

×1:	5 Hz - 50 Hz
×10:	50 Hz - 500 Hz
×100:	500 Hz - 5 kHz
×1k:	5 kHz - 50 kHz
×10k:	50 kHz - 500 kHz

Frequency accuracy:	±(3% + 1 Hz)
Output impedance:	600 Ω ±10%, unbalanced
Output attenuators:	10-dB step × 7 1-dB step × 9 0.1-dB step × 9
Output terminal:	BNC receptacle
Output waveform:	Sinusoidal wave or pulse wave
Sinusoidal output	
Maximum output voltage:	3.16 Vrms ±5% (with 0 dB = 3.16 Vrms (open end), with VARIABLE vernier knob set to the CAL'D position)
Vernier range:	0.3 dB or over (continuously-variable output voltage range, with VARIABLE vernier knob)
Distortion factor:	10 Hz - 20 kHz: 0.005% or better 20 kHz - 50 kHz: 0.01% or better (except ×10k range) 5 Hz - 500 kHz: 0.1% or better

Output frequency vs voltage characteristics:	5 Hz - 20 kHz :	±0.2 dB or better	(with reference to 1 kHz, 600 Ω resistive load, with maximum output voltage)
	20 kHz - 500 kHz:	±0.5 dB or better	

Pulse wave: (600-Ω load)

- Maximum output voltage: 4 Vp-p or over
- Rise time: 200 ns or faster (with output -30 dB or over)
- Overshoot: 5 % or less (with output -30 dB or over)
- Sag: 5 % or less (with output -30 dB or over, at 30 Hz)

TTL output: (with BNC receptacle on rear panel)

LO level: 0 - 0.5 V

HI level: 4.5 V - 5.25 V

Fanout: 1 (TTL, 74 Series)

Accessories:

Instruction Manual ---------- 1

Fuse (0.3 A) ---------- 1

3. PRECAUTIONS BEFORE USE

3.1 Unpacking and Inspection

The instrument is shipped after being fully inspected and tested at the factory. Upon receipt of the instrument, immediately unpack and inspect it for any signs of damage which might have been sustained when in transportation. If any damage is found, immediately notify the transportation company and/or your Kikusui agent.

3.2 Check of AC Line Voltage

The AC line voltage on which the instrument operates is selectable with the voltage selector plug on the rear panel, as shown in the below table. Before connecting the power cord of the instrument to an AC line outlet, make sure that the voltage selector plug is correctly set in the position corresponding to the AC line voltage. Normally, the instrument is shipped being set for line voltage 90 - 110 V and with fuse 0.5 A. Note that the instrument may not operate normally or may be damaged if it is operated on a wrong AC line voltage.

Table 3-1

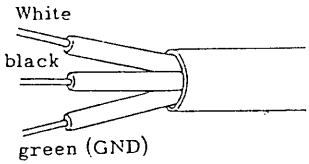
Selector plug setting	Nominal voltage	Voltage tolerance	Fuse
A	100 V	90 - 110 V	0.5 A
B	115 V	104 - 126 V	
C	215 V	194 - 236 V	0.3 A
D	230 V	207 - 253 V	

The power cord of the instrument has a 3P plug. To operate the instrument on a 2P receptacle which has no pin for the ground line, use the AC plug adaptor (3p-2p) which is supplied as an accessory item.

* Note that the use of the 3p-2p adaptor is limited to the 90 - 110 V range and 104 - 126 V range. The instrument casing can be grounded by connecting the ground wire of the adaptor to a ground line.

* The uncovered metallic terminal on the rear panel of the instrument also is a ground terminal. It is highly recommended to connect securely this terminal to a ground line before connecting the power cord to an AC line receptacle.

* Power Cable(3-core cable)



* Please be advised beforehand that the above matter may cause some alteration against explanation or circuit diagram in the instruction manual. Before using the instrument, it is requested to fix a suitable plug for the voltage used.

3.3 Operating Environments

Do not operate the instrument in direct sunlight or near a source of heat. Avoid operating the instrument in adverse environments such as dusty or corrosive gas atmosphere, chemical stains, mechanical vibration, etc. Note that the longevity of the instrument may be badly shortened if it is exposed to such adverse environments.

3.4 Protection of Output Circuit

Note that the instrument may be damaged if a voltage is applied to the output terminal of the instrument. Be sure to operate the instrument with no voltage applied to its output terminal.

3.5 Output Cable

The output cable should be short. If a long cable is used, the output voltage/frequency characteristics of sinusoidal wave and rise time characteristics of pulse wave may be degraded. Use an output cable as short as possible, to reduce stray capacitance.

3.6 Note

The specifications mentioned in this publication are subject to change without notice.

4. OPERATION METHOD

4.1 Description of Front Panel Items

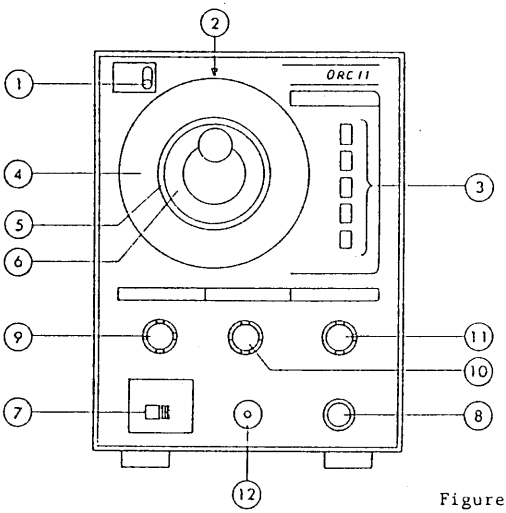


Figure 4-1

(1)	POWER switch:	Main power switch
(2)	[▽] indicator:	LED for power indication and for frequency dial index
(3)	FREQUENCY (Hz) [×1] - [×10k] buttons:	To select an oscillating frequency range. The oscillating frequency is as indicated by the FREQUENCY dial and multiplied by the factor selected by one of these buttons.
(4)	FREQUENCY dial:	Continuously-variable adjustment of oscillating frequency, to a factor of 10 times.
(5)	COARSE knob:	Knobs to drive the FREQUENCY dial. The outer knob is for coarse adjustment and the inner knob is for fine adjustment. The driving ratio is approximately 1:6.
(6)	FINE knob:	

⑦ WAVEFORM switch: [⊓] [∿]

To select either sinusoidal wave or pulse wave of output. Of either waveform, the signal is deflected with the zero-volt line as the center of deflection.

⑧ ∿ VARIABLE knob:

For continuously variable adjustment of the sinusoidal output voltage to a factor of approximately 0.5 dB. The output voltage decreases as this knob is turned counter-clockwise. The clockwise extreme position (CAL'D position) is for the calibrated voltage of sinusoidal output signal.

OUTPUT (-dB):

Attenuator to adjust the output voltage of sinusoidal wave or pulse wave.

⑨ [70] - [0]:
⑩ [9] - [0]:
⑪ [0.9] - [0]:

These rotary switches are for adjustment of output voltage.

In the case of the sinusoidal wave output, the output is 3.16 Vrms (open end) when ⑧ is set at the CAL'D position and ⑨, ⑩ and ⑪ are set at 0 dB.

In the case of the pulse wave output, the output is approximately 10 Vp-p (open end) irrespective of setting of ⑧ when ⑨, ⑩ and ⑪ are set at 0 dB.

[⚠],[□],[□]

If rotary switch ⑨ is turned counterclockwise further from the [70] position, the output is reduced to 80 dB, 90 dB in the medium frequency range (approximately 20 kHz), although the frequency vs voltage characteristics at the high frequency range are substantially shifted.

⑫ OUTPUT [600Ω] terminal:

The output terminal with output impedance 600 ohms. The GND line (outer conductor) is connected to the instrument chassis.

4.2 Description of Rear Panel Items

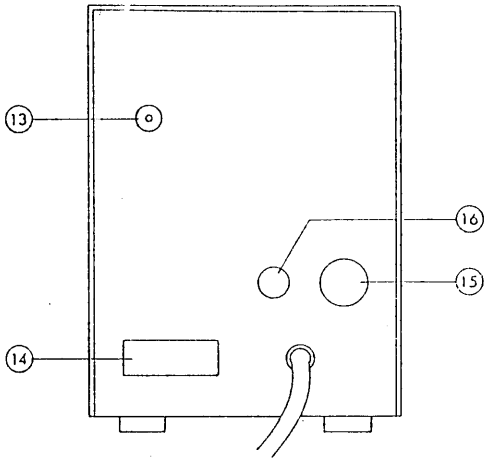


Figure 4-2

⑬ TTL OUT terminal: This terminal delivers a TTL-level pulse signal which is synchronized with the oscillating frequency of the instrument. This signal can drive one 74-series TTL gate (or four 74LS-series gates).

⑭ AC line voltage selector: To select the AC line voltage by setting the arrowhead mark in the correct position.

Note: Be sure to disconnect the AC power cord from the AC line receptacle before changing the position of the arrowhead mark.

⑮ Fuse: AC input power fuse.

Note: Use the fuse corresponding to the AC line voltage. (See Table 3.1.)

⑯ GND terminal: Ground terminal (connected to the instrument casing.)

4.3 Operation Method

4.3.1 Setting of Oscillating Frequency

Select the oscillating frequency with (3) FREQUENCY (Hz) buttons and (4) FREQUENCY dial. The oscillating frequency is as indicated by the dial and multiplied by the factor ([×1] - [×10k]) selected by the FREQUENCY (Hz) buttons.

Example: To select 20 kHz, proceed as follows:

(1) Press the [×1k] button.

(2) Set the FREQUENCY dial to the "20" position.

4.3.2 Output Waveform Selection

Select the sinusoidal wave or the pulse wave by throwing (7) WAVEFORM switch to the [⊓] or [∿] position.

4.3.3 Setting of Output Voltage

(1) Sinusoidal wave output:

The output voltage is adjustable with reference to 0 dB = 3.16 Vrms (open end) in 10-dB, 1-dB and 0.1-dB steps with (9), (10) and (11) rotary switches and with (8) [∿] VARIABLE potentiometer. The relationships between dB and voltage when the [∿] VARIABLE potentiometer is set in the CAL'D position are shown in Table 4-1.

(2) Pulse wave output:

The 0 dB of the pulse wave output is approximately 10 Vp-p when open-ended or approximately 5 Vp-p when terminated with 600-ohm load. The relationships between dB values and peak voltage values are shown in Table 4-2. The values shown in the table are in percentage of the attenuated voltage with reference to the 0 dB as 100%.

Table 4-1-1. dB values vs voltage values (Vrms), sinusoidal wave
0 to -39.9 dB (in 0.1-dB steps) (calculative value)

dB	Open end	600 Ω load	dB	Open end	600 Ω load	dB	Open end	600 Ω load	dB	Open end	600 Ω load
0dB	3.16 V	1.58 V	-10dB	1.00 V	500 mV	-20dB	316 mV	158 mV	-30dB	100 mV	50.0 mV
	3.13 V	1.56 V		989 mV	494 mV		313 mV	156 mV		98.9 mV	49.4 mV
	3.09 V	1.55 V		977 mV	489 mV		309 mV	155 mV		97.7 mV	48.9 mV
	3.05 V	1.53 V		966 mV	483 mV		305 mV	153 mV		96.6 mV	48.3 mV
	3.02 V	1.51 V		955 mV	477 mV		302 mV	151 mV		95.5 mV	47.7 mV
	2.99 V	1.49 V		944 mV	472 mV		299 mV	149 mV		94.4 mV	47.2 mV
	2.95 V	1.48 V		933 mV	467 mV		295 mV	148 mV		93.3 mV	46.7 mV
	2.92 V	1.46 V		923 mV	461 mV		292 mV	146 mV		92.3 mV	46.1 mV
	2.88 V	1.44 V		912 mV	456 mV		288 mV	144 mV		91.2 mV	45.6 mV
	2.85 V	1.43 V		902 mV	451 mV		285 mV	143 mV		90.2 mV	45.1 mV
-1dB	2.82 V	1.41 V	-11dB	891 mV	446 mV	-21dB	282 mV	141 mV	-31dB	89.1 mV	44.6 mV
	2.79 V	1.39 V		881 mV	441 mV		279 mV	139 mV		88.1 mV	44.1 mV
	2.75 V	1.38 V		871 mV	435 mV		275 mV	138 mV		87.1 mV	43.5 mV
	2.72 V	1.36 V		861 mV	430 mV		272 mV	136 mV		86.1 mV	43.0 mV
	2.69 V	1.35 V		851 mV	426 mV		269 mV	135 mV		85.1 mV	42.6 mV
	2.66 V	1.33 V		841 mV	421 mV		266 mV	133 mV		84.1 mV	42.1 mV
	2.63 V	1.32 V		832 mV	416 mV		263 mV	132 mV		83.2 mV	41.6 mV
	2.60 V	1.30 V		822 mV	411 mV		260 mV	130 mV		82.2 mV	41.1 mV
	2.57 V	1.29 V		813 mV	406 mV		257 mV	129 mV		81.3 mV	40.6 mV
	2.54 V	1.27 V		804 mV	402 mV		254 mV	127 mV		80.4 mV	40.2 mV
-2dB	2.51 V	1.26 V	-12dB	794 mV	397 mV	-22dB	251 mV	126 mV	-32dB	79.4 mV	39.7 mV
	2.48 V	1.24 V		785 mV	393 mV		248 mV	124 mV		78.5 mV	39.3 mV
	2.45 V	1.23 V		776 mV	388 mV		245 mV	123 mV		77.6 mV	38.8 mV
	2.43 V	1.21 V		767 mV	384 mV		243 mV	121 mV		76.7 mV	38.4 mV
	2.40 V	1.20 V		759 mV	379 mV		240 mV	120 mV		75.9 mV	37.9 mV
	2.37 V	1.19 V		750 mV	375 mV		237 mV	119 mV		75.0 mV	37.5 mV
	2.34 V	1.17 V		741 mV	371 mV		234 mV	117 mV		74.1 mV	37.1 mV
	2.32 V	1.16 V		733 mV	366 mV		232 mV	116 mV		73.3 mV	36.6 mV
	2.29 V	1.15 V		724 mV	362 mV		229 mV	115 mV		72.4 mV	36.2 mV
	2.26 V	1.13 V		716 mV	358 mV		226 mV	113 mV		71.6 mV	35.8 mV
-3dB	2.24 V	1.12 V	-13dB	708 mV	354 mV	-23dB	224 mV	112 mV	-33dB	70.8 mV	35.4 mV
	2.21 V	1.11 V		700 mV	350 mV		221 mV	111 mV		70.0 mV	35.0 mV
	2.19 V	1.09 V		692 mV	346 mV		219 mV	109 mV		69.2 mV	34.6 mV
	2.16 V	1.08 V		684 mV	342 mV		216 mV	108 mV		68.4 mV	34.2 mV
	2.14 V	1.07 V		676 mV	338 mV		214 mV	107 mV		67.6 mV	33.8 mV
	2.11 V	1.06 V		668 mV	334 mV		211 mV	106 mV		66.8 mV	33.4 mV
	2.09 V	1.05 V		661 mV	330 mV		209 mV	104 mV		66.1 mV	33.0 mV
	2.07 V	1.03 V		653 mV	327 mV		207 mV	103 mV		65.3 mV	32.7 mV
	2.04 V	1.02 V		646 mV	323 mV		204 mV	102 mV		64.6 mV	32.3 mV
	2.02 V	1.01 V		638 mV	319 mV		202 mV	101 mV		63.8 mV	31.9 mV
-4dB	2.00 V	1.00 V	-14dB	631 mV	315 mV	-24dB	200 mV	100 mV	-34dB	63.1 mV	31.5 mV
	1.97 V	986 mV		624 mV	312 mV		197 mV	98.6 mV		62.4 mV	31.2 mV
	1.95 V	975 mV		617 mV	308 mV		195 mV	97.5 mV		61.7 mV	30.8 mV
	1.93 V	964 mV		610 mV	305 mV		193 mV	96.4 mV		61.0 mV	30.5 mV
	1.91 V	953 mV		603 mV	301 mV		191 mV	95.3 mV		60.3 mV	30.1 mV
	1.88 V	942 mV		596 mV	298 mV		188 mV	94.2 mV		59.6 mV	29.8 mV
	1.86 V	931 mV		589 mV	294 mV		186 mV	93.1 mV		58.9 mV	29.4 mV
	1.84 V	926 mV		582 mV	291 mV		184 mV	92.6 mV		58.2 mV	29.1 mV
	1.82 V	918 mV		575 mV	288 mV		182 mV	91.8 mV		57.5 mV	28.8 mV
	1.80 V	899 mV		569 mV	284 mV		180 mV	89.9 mV		56.9 mV	28.4 mV
-5dB	1.78 V	889 mV	-15dB	562 mV	281 mV	-25dB	178 mV	88.9 mV	-35dB	56.2 mV	28.1 mV
	1.76 V	879 mV		556 mV	278 mV		176 mV	87.9 mV		55.6 mV	27.8 mV
	1.74 V	869 mV		550 mV	275 mV		174 mV	86.9 mV		55.0 mV	27.5 mV
	1.72 V	859 mV		543 mV	272 mV		172 mV	85.9 mV		54.3 mV	27.2 mV
	1.70 V	849 mV		537 mV	269 mV		170 mV	84.9 mV		53.7 mV	26.9 mV
	1.68 V	839 mV		531 mV	265 mV		168 mV	83.9 mV		53.1 mV	26.5 mV
	1.66 V	830 mV		525 mV	262 mV		166 mV	83.0 mV		52.5 mV	26.2 mV
	1.64 V	820 mV		519 mV	259 mV		164 mV	82.0 mV		51.9 mV	25.9 mV
	1.62 V	811 mV		513 mV	256 mV		162 mV	81.1 mV		51.3 mV	25.6 mV
	1.60 V	802 mV		507 mV	253 mV		160 mV	80.2 mV		50.7 mV	25.3 mV
-6dB	1.58 V	792 mV	-16dB	501 mV	251 mV	-26dB	158 mV	79.2 mV	-36dB	50.1 mV	25.1 mV
	1.57 V	783 mV		495 mV	248 mV		157 mV	78.3 mV		49.5 mV	24.8 mV
	1.55 V	774 mV		490 mV	245 mV		155 mV	77.4 mV		49.0 mV	24.5 mV
	1.53 V	766 mV		484 mV	242 mV		153 mV	76.6 mV		48.4 mV	24.2 mV
	1.51 V	757 mV		479 mV	239 mV		151 mV	75.7 mV		47.9 mV	23.9 mV
	1.50 V	748 mV		473 mV	237 mV		150 mV	74.8 mV		47.3 mV	23.7 mV
	1.48 V	748 mV		468 mV	234 mV		148 mV	74.8 mV		46.8 mV	23.4 mV
	1.46 V	731 mV		462 mV	231 mV		146 mV	73.1 mV		46.2 mV	23.1 mV
	1.45 V	723 mV		457 mV	229 mV		145 mV	72.3 mV		45.7 mV	22.9 mV
	1.43 V	714 mV		452 mV	226 mV		143 mV	71.4 mV		45.2 mV	22.6 mV
-7dB	1.41 V	706 mV	-17dB	447 mV	223 mV	-27dB	141 mV	70.6 mV	-37dB	44.7 mV	22.3 mV
	1.40 V	698 mV		442 mV	221 mV		140 mV	69.8 mV		44.2 mV	22.1 mV
	1.38 V	690 mV		437 mV	218 mV		138 mV	69.0 mV		43.7 mV	21.8 mV
	1.36 V	682 mV		432 mV	216 mV		136 mV	68.2 mV		43.2 mV	21.6 mV
	1.35 V	674 mV		427 mV	213 mV		135 mV	67.4 mV		42.7 mV	21.3 mV
	1.33 V	667 mV		422 mV	211 mV		133 mV	66.7 mV		42.2 mV	21.1 mV
	1.32 V	659 mV		417 mV	208 mV		132 mV	65.9 mV		41.7 mV	20.8 mV
	1.30 V	652 mV		412 mV	206 mV		130 mV	65.2 mV		41.2 mV	20.6 mV
	1.29 V	644 mV		407 mV	204 mV		129 mV	64.4 mV		40.7 mV	20.4 mV
	1.27 V	637 mV		403 mV	201 mV		127 mV	63.7 mV		40.3 mV	20.1 mV
-8dB	1.26 V	629 mV	-18dB	398 mV	199 mV	-28dB	126 mV	62.9 mV	-38dB	39.8 mV	19.9 mV
	1.24 V	622 mV		394 mV	197 mV		124 mV	62.2 mV		39.4 mV	19.7 mV
	1.23 V	615 mV		389 mV	195 mV		123 mV	61.5 mV		38.9 mV	19.5 mV
	1.22 V	608 mV		385 mV	192 mV		122 mV	60.8 mV		38.5 mV	19.2 mV
	1.20 V	601 mV		380 mV	190 mV		120 mV	60.1 mV		38.0 mV	19.0 mV
	1.19 V	594 mV		376 mV	188 mV		119 mV	59.4 mV		37.6 mV	18.8 mV
	1.17 V	587 mV		372 mV	186 mV		117 mV	58.7 mV		37.2 mV	18.6 mV
	1.16 V	581 mV		367 mV	184 mV		116 mV	58.1 mV		36.7 mV	18.4 mV
	1.15 V	574 mV		363 mV	182 mV		115 mV	57.4 mV		36.3 mV	18.2 mV
	1.14 V	568 mV		359 mV	179 mV		114 mV	56.8 mV		35.9 mV	17.9 mV
-9dB	1.12 V	561 mV	-19dB	355 mV	177 mV	-29dB	112 mV	56.1 mV	-39dB	35.5 mV	17.7 mV
	1.11 V	555 mV		351 mV	175 mV		111 mV	55.5 mV		35.1 mV	17.5 mV
	1.10 V	548 mV		347 mV	173 mV		110 mV	54.8 mV		34.7 mV	17.3 mV
	1.09 V	542 mV		343 mV	171 mV		108 mV	54.2 mV		34.3 mV	17.1 mV
	1.07 V	536 mV		339 mV	169 mV		107 mV	53.6 mV		33.9 mV	16.9 mV
	1.06 V	530 mV		335 mV	167 mV		106 mV	53.0 mV		33.5 mV	16.7 mV
	1.05 V	524 mV		331 mV	166 mV		105 mV	52.4 mV		33.1 mV	16.6 mV
	1.04 V	518 mV		327 mV	164 mV		104 mV	51.8 mV		32.7 mV	16.4 mV
	1.02 V	512 mV		324 mV	162 mV		102 mV	51.2 mV		32.4 mV	16.2 mV
	1.01 V	506 mV		320 mV	160 mV		101 mV	50.6 mV		32.0 mV	16.0 mV

Table 4-1-2. dB values vs voltage values (Vrms), sinusoidal wave
0 to -39.9 dB (in 0.1-dB steps) (calculative value)

dB	Open end	600 Ω load	dB	Open end	600 Ω load	dB	Open end	600 Ω load	dB	Open end	600 Ω load
-40dB	31.6 mV	15.8 mV	-50dB	10.0 mV	5.00 mV	-60dB	3.16 mV	1.58 mV	-70dB	1.00 mV	0.500 mV
	31.3 mV	15.6 mV		9.89 mV	4.94 mV		3.13 mV	1.56 mV		0.989 mV	0.494 mV
	30.9 mV	15.5 mV		9.77 mV	4.89 mV		3.09 mV	1.55 mV		0.977 mV	0.489 mV
	30.5 mV	15.3 mV		9.66 mV	4.83 mV		3.05 mV	1.53 mV		0.966 mV	0.483 mV
	30.2 mV	15.1 mV		9.55 mV	4.78 mV		3.02 mV	1.51 mV		0.955 mV	0.478 mV
	29.9 mV	14.9 mV		9.44 mV	4.72 mV		2.99 mV	1.49 mV		0.944 mV	0.472 mV
	29.5 mV	14.8 mV		9.33 mV	4.67 mV		2.95 mV	1.48 mV		0.933 mV	0.467 mV
	29.2 mV	14.6 mV		9.23 mV	4.61 mV		2.92 mV	1.46 mV		0.923 mV	0.461 mV
	28.9 mV	14.4 mV		9.12 mV	4.56 mV		2.88 mV	1.44 mV		0.912 mV	0.456 mV
	28.5 mV	14.3 mV		9.02 mV	4.51 mV		2.85 mV	1.43 mV		0.902 mV	0.451 mV
-41dB	28.2 mV	14.1 mV	-51dB	8.91 mV	4.46 mV	-61dB	2.82 mV	1.41 mV	-71dB	0.891 mV	0.446 mV
	27.9 mV	13.9 mV		8.81 mV	4.41 mV		2.79 mV	1.39 mV		0.881 mV	0.441 mV
	27.5 mV	13.8 mV		8.71 mV	4.35 mV		2.75 mV	1.38 mV		0.871 mV	0.435 mV
	27.2 mV	13.6 mV		8.61 mV	4.31 mV		2.72 mV	1.36 mV		0.861 mV	0.431 mV
	26.9 mV	13.5 mV		8.51 mV	4.26 mV		2.69 mV	1.35 mV		0.851 mV	0.426 mV
	26.6 mV	13.3 mV		8.41 mV	4.21 mV		2.66 mV	1.33 mV		0.841 mV	0.421 mV
	26.3 mV	13.2 mV		8.32 mV	4.16 mV		2.63 mV	1.32 mV		0.832 mV	0.416 mV
	26.0 mV	13.0 mV		8.22 mV	4.11 mV		2.60 mV	1.30 mV		0.822 mV	0.411 mV
	25.7 mV	12.9 mV		8.13 mV	4.06 mV		2.57 mV	1.29 mV		0.813 mV	0.406 mV
	25.4 mV	12.7 mV		8.04 mV	4.02 mV		2.54 mV	1.27 mV		0.804 mV	0.402 mV
-42dB	25.1 mV	12.6 mV	-52dB	7.94 mV	3.97 mV	-62dB	2.51 mV	1.26 mV	-72dB	0.794 mV	0.397 mV
	24.8 mV	12.4 mV		7.85 mV	3.93 mV		2.48 mV	1.24 mV		0.785 mV	0.393 mV
	24.5 mV	12.3 mV		7.76 mV	3.88 mV		2.45 mV	1.23 mV		0.776 mV	0.388 mV
	24.3 mV	12.1 mV		7.67 mV	3.84 mV		2.43 mV	1.21 mV		0.767 mV	0.384 mV
	24.0 mV	12.0 mV		7.58 mV	3.79 mV		2.40 mV	1.20 mV		0.758 mV	0.379 mV
	23.7 mV	11.9 mV		7.50 mV	3.75 mV		2.37 mV	1.19 mV		0.750 mV	0.375 mV
	23.4 mV	11.7 mV		7.41 mV	3.71 mV		2.34 mV	1.17 mV		0.741 mV	0.371 mV
	23.2 mV	11.6 mV		7.33 mV	3.66 mV		2.32 mV	1.16 mV		0.733 mV	0.366 mV
	22.9 mV	11.5 mV		7.24 mV	3.62 mV		2.29 mV	1.15 mV		0.724 mV	0.362 mV
	22.6 mV	11.3 mV		7.16 mV	3.58 mV		2.26 mV	1.13 mV		0.716 mV	0.358 mV
-43dB	22.4 mV	11.2 mV	-53dB	7.08 mV	3.54 mV	-63dB	2.24 mV	1.12 mV	-73dB	0.708 mV	0.354 mV
	22.1 mV	11.1 mV		7.00 mV	3.50 mV		2.21 mV	1.11 mV		0.700 mV	0.350 mV
	21.9 mV	10.9 mV		6.92 mV	3.46 mV		2.19 mV	1.09 mV		0.692 mV	0.346 mV
	21.6 mV	10.8 mV		6.84 mV	3.42 mV		2.16 mV	1.08 mV		0.684 mV	0.342 mV
	21.4 mV	10.7 mV		6.76 mV	3.38 mV		2.14 mV	1.07 mV		0.676 mV	0.338 mV
	21.1 mV	10.6 mV		6.68 mV	3.34 mV		2.11 mV	1.06 mV		0.668 mV	0.334 mV
	20.9 mV	10.4 mV		6.61 mV	3.30 mV		2.09 mV	1.04 mV		0.661 mV	0.330 mV
	20.7 mV	10.3 mV		6.53 mV	3.27 mV		2.07 mV	1.03 mV		0.653 mV	0.327 mV
	20.4 mV	10.2 mV		6.46 mV	3.23 mV		2.04 mV	1.02 mV		0.646 mV	0.323 mV
	20.2 mV	10.1 mV		6.38 mV	3.19 mV		2.02 mV	1.01 mV		0.638 mV	0.319 mV
-44dB	20.0 mV	10.0 mV	-54dB	6.31 mV	3.15 mV	-64dB	2.00 mV	1.00 mV	-74dB	0.631 mV	0.315 mV
	19.7 mV	9.86 mV		6.24 mV	3.12 mV		1.97 mV	0.986 mV		0.624 mV	0.312 mV
	19.5 mV	9.75 mV		6.17 mV	3.08 mV		1.95 mV	0.975 mV		0.617 mV	0.308 mV
	19.3 mV	9.64 mV		6.10 mV	3.05 mV		1.93 mV	0.964 mV		0.610 mV	0.305 mV
	19.1 mV	9.53 mV		6.03 mV	3.01 mV		1.91 mV	0.953 mV		0.603 mV	0.301 mV
	18.8 mV	9.42 mV		5.96 mV	2.98 mV		1.88 mV	0.942 mV		0.596 mV	0.298 mV
	18.6 mV	9.31 mV		5.89 mV	2.94 mV		1.86 mV	0.931 mV		0.589 mV	0.294 mV
	18.4 mV	9.20 mV		5.82 mV	2.91 mV		1.84 mV	0.920 mV		0.582 mV	0.291 mV
	18.2 mV	9.10 mV		5.75 mV	2.88 mV		1.82 mV	0.910 mV		0.575 mV	0.288 mV
	18.0 mV	8.99 mV		5.69 mV	2.84 mV		1.80 mV	0.899 mV		0.569 mV	0.284 mV
-45dB	17.8 mV	8.89 mV	-55dB	5.62 mV	2.81 mV	-65dB	1.78 mV	0.889 mV	-75dB	0.562 mV	0.281 mV
	17.6 mV	8.79 mV		5.56 mV	2.78 mV		1.76 mV	0.879 mV		0.556 mV	0.278 mV
	17.4 mV	8.69 mV		5.50 mV	2.75 mV		1.74 mV	0.869 mV		0.550 mV	0.275 mV
	17.2 mV	8.59 mV		5.43 mV	2.72 mV		1.72 mV	0.859 mV		0.543 mV	0.272 mV
	17.0 mV	8.49 mV		5.37 mV	2.69 mV		1.70 mV	0.849 mV		0.537 mV	0.269 mV
	16.8 mV	8.39 mV		5.31 mV	2.65 mV		1.68 mV	0.839 mV		0.531 mV	0.265 mV
	16.6 mV	8.30 mV		5.25 mV	2.62 mV		1.66 mV	0.830 mV		0.525 mV	0.262 mV
	16.4 mV	8.20 mV		5.19 mV	2.59 mV		1.64 mV	0.820 mV		0.519 mV	0.259 mV
	16.2 mV	8.11 mV		5.13 mV	2.56 mV		1.62 mV	0.811 mV		0.513 mV	0.256 mV
	16.0 mV	8.02 mV		5.07 mV	2.54 mV		1.60 mV	0.802 mV		0.507 mV	0.254 mV
-46dB	15.8 mV	7.92 mV	-56dB	5.01 mV	2.51 mV	-66dB	1.58 mV	0.793 mV	-76dB	0.501 mV	0.251 mV
	15.7 mV	7.83 mV		4.95 mV	2.48 mV		1.57 mV	0.783 mV		0.495 mV	0.248 mV
	15.5 mV	7.74 mV		4.90 mV	2.45 mV		1.55 mV	0.774 mV		0.490 mV	0.245 mV
	15.3 mV	7.66 mV		4.84 mV	2.42 mV		1.53 mV	0.766 mV		0.484 mV	0.242 mV
	15.1 mV	7.57 mV		4.79 mV	2.39 mV		1.51 mV	0.757 mV		0.479 mV	0.239 mV
	15.0 mV	7.48 mV		4.73 mV	2.37 mV		1.50 mV	0.748 mV		0.473 mV	0.237 mV
	14.8 mV	7.40 mV		4.68 mV	2.34 mV		1.48 mV	0.740 mV		0.468 mV	0.234 mV
	14.6 mV	7.31 mV		4.63 mV	2.31 mV		1.46 mV	0.731 mV		0.463 mV	0.231 mV
	14.5 mV	7.23 mV		4.58 mV	2.29 mV		1.45 mV	0.723 mV		0.458 mV	0.229 mV
	14.3 mV	7.14 mV		4.53 mV	2.26 mV		1.43 mV	0.714 mV		0.453 mV	0.226 mV
-47dB	14.1 mV	7.06 mV	-57dB	4.47 mV	2.23 mV	-67dB	1.41 mV	0.706 mV	-77dB	0.447 mV	0.223 mV
	14.0 mV	6.98 mV		4.42 mV	2.21 mV		1.40 mV	0.698 mV		0.442 mV	0.221 mV
	13.8 mV	6.90 mV		4.37 mV	2.18 mV		1.38 mV	0.690 mV		0.437 mV	0.218 mV
	13.6 mV	6.82 mV		4.32 mV	2.16 mV		1.36 mV	0.682 mV		0.432 mV	0.216 mV
	13.5 mV	6.74 mV		4.27 mV	2.13 mV		1.35 mV	0.674 mV		0.427 mV	0.213 mV
	13.3 mV	6.67 mV		4.22 mV	2.11 mV		1.33 mV	0.667 mV		0.422 mV	0.211 mV
	13.2 mV	6.59 mV		4.17 mV	2.08 mV		1.32 mV	0.659 mV		0.417 mV	0.208 mV
	13.0 mV	6.52 mV		4.12 mV	2.06 mV		1.30 mV	0.652 mV		0.412 mV	0.206 mV
	12.9 mV	6.44 mV		4.07 mV	2.04 mV		1.29 mV	0.644 mV		0.407 mV	0.204 mV
	12.7 mV	6.37 mV		4.03 mV	2.01 mV		1.27 mV	0.637 mV		0.403 mV	0.201 mV
-48dB	12.6 mV	6.29 mV	-58dB	3.98 mV	1.99 mV	-68dB	1.26 mV	0.629 mV	-78dB	0.398 mV	0.199 mV
	12.4 mV	6.22 mV		3.94 mV	1.97 mV		1.24 mV	0.622 mV		0.394 mV	0.197 mV
	12.3 mV	6.15 mV		3.89 mV	1.95 mV		1.23 mV	0.615 mV		0.389 mV	0.195 mV
	12.2 mV	6.08 mV		3.85 mV	1.92 mV		1.22 mV	0.608 mV		0.385 mV	0.192 mV
	12.0 mV	6.01 mV		3.80 mV	1.90 mV		1.20 mV	0.601 mV		0.380 mV	0.190 mV
	11.9 mV	5.94 mV		3.76 mV	1.88 mV		1.19 mV	0.594 mV		0.376 mV	0.188 mV
	11.7 mV	5.87 mV		3.72 mV	1.86 mV		1.17 mV	0.587 mV		0.372 mV	0.186 mV
	11.6 mV	5.81 mV		3.67 mV	1.84 mV		1.16 mV	0.581 mV		0.367 mV	0.184 mV
	11.5 mV	5.74 mV		3.63 mV	1.82 mV		1.15 mV	0.574 mV		0.363 mV	0.182 mV
	11.4 mV	5.68 mV		3.59 mV	1.79 mV		1.14 mV	0.568 mV		0.359 mV	0.179 mV
-49dB	11.2 mV	5.61 mV	-59dB	3.55 mV	1.77 mV	-69dB	1.12 mV	0.561 mV	-79dB	0.355 mV	0.177 mV
	11.1 mV	5.55 mV		3.51 mV	1.75 mV		1.11 mV	0.555 mV		0.351 mV	0.175 mV
	11.0 mV	5.48 mV		3.47 mV	1.73 mV		1.10 mV	0.548 mV		0.347 mV	0.173 mV
	10.8 mV	5.42 mV		3.43 mV	1.71 mV		1.08 mV	0.542 mV		0.343 mV	0.171 mV
	10.7 mV	5.36 mV		3.39 mV	1.69 mV		1.07 mV	0.536 mV		0.339 mV	0.169 mV
	10.6 mV	5.30 mV		3.35 mV	1.67 mV		1.06 mV	0.530 mV		0.335 mV	0.167 mV
	10.5 mV	5.24 mV		3.31 mV	1.66 mV		1.05 mV	0.524 mV		0.331 mV	0.166 mV
	10.4 mV	5.18 mV		3.27 mV	1.64 mV		1.04 mV	0.518 mV		0.327 mV	0.164 mV
	10.2 mV	5.12 mV		3.24 mV	1.62 mV		1.02 mV	0.512 mV		0.324 mV	0.162 mV
	10.1 mV	5.06 mV		3.20 mV	1.60 mV		1.01 mV	0.506 mV		0.320 mV	0.160 mV

Table 4-2. dB values vs voltage values (Vp-p), pulse wave
Relationships between dB and percentage of voltage with reference to 0 dB = 10 Vp-p (open end) or 0 dB = 5 Vp-p (600 Ω load) as 100%
0 to -79.9 dB (in 0.1-dB steps) (calculative value)

dB	%	dB	%	dB	%	dB	%	dB	%	dB	%	dB	%	dB	%
0dB	100	-10dB	31.6	-20dB	10.0	-30dB	3.16	-40dB	1.00	-50dB	0.316	-60dB	0.100	-70dB	0.0316
	98.9		31.3		9.89		3.13		0.989		0.313		0.0989		0.0313
	97.7		30.9		9.77		3.09		0.977		0.309		0.0977		0.0309
	96.6		30.5		9.66		3.05		0.966		0.305		0.0966		0.0305
	95.5		30.2		9.55		3.02		0.955		0.302		0.0955		0.0302
	94.4		29.9		9.44		2.99		0.944		0.299		0.0944		0.0299
	93.3		29.5		9.33		2.95		0.933		0.295		0.0933		0.0295
	92.3		29.2		9.23		2.92		0.923		0.292		0.0923		0.0292
	91.2		28.8		9.12		2.88		0.912		0.288		0.0912		0.0288
	90.2		28.5		9.02		2.85		0.902		0.285		0.0902		0.0285
-1dB	89.1	-11dB	28.2	-21dB	8.91	-31dB	2.82	-41dB	0.891	-51dB	0.282	-61dB	0.0891	-71dB	0.0282
	88.1		27.9		8.81		2.79		0.881		0.279		0.0881		0.0279
	87.1		27.5		8.71		2.75		0.871		0.275		0.0871		0.0275
	86.1		27.2		8.61		2.72		0.861		0.272		0.0861		0.0272
	85.1		26.9		8.51		2.69		0.851		0.269		0.0851		0.0269
	84.1		26.6		8.41		2.66		0.841		0.266		0.0841		0.0266
	83.2		26.3		8.32		2.63		0.832		0.263		0.0832		0.0263
	82.2		26.0		8.22		2.60		0.822		0.260		0.0822		0.0260
	81.3		25.7		8.13		2.57		0.813		0.257		0.0813		0.0257
	80.4		25.4		8.04		2.54		0.804		0.254		0.0804		0.0254
-2dB	79.4	-12dB	25.1	-22dB	7.94	-32dB	2.51	-42dB	0.794	-52dB	0.251	-62dB	0.0794	-72dB	0.0251
	78.5		24.8		7.85		2.48		0.785		0.248		0.0785		0.0248
	77.6		24.5		7.76		2.45		0.776		0.245		0.0776		0.0245
	76.7		24.3		7.67		2.43		0.767		0.243		0.0767		0.0243
	75.9		24.0		7.59		2.40		0.759		0.240		0.0759		0.0240
	75.0		23.7		7.50		2.37		0.750		0.237		0.0750		0.0237
	74.1		23.4		7.41		2.34		0.741		0.234		0.0741		0.0234
	73.3		23.2		7.33		2.32		0.733		0.232		0.0733		0.0232
	72.4		22.9		7.24		2.29		0.724		0.229		0.0724		0.0229
	71.6		22.6		7.16		2.26		0.716		0.226		0.0716		0.0226
-3dB	70.8	-13dB	22.4	-23dB	7.08	-33dB	2.24	-43dB	0.708	-53dB	0.224	-63dB	0.0708	-73dB	0.0224
	70.0		22.1		7.00		2.21		0.700		0.221		0.0700		0.0221
	69.2		21.9		6.92		2.19		0.692		0.219		0.0692		0.0219
	68.4		21.6		6.84		2.16		0.684		0.216		0.0684		0.0216
	67.6		21.4		6.76		2.14		0.676		0.214		0.0676		0.0214
	66.9		21.1		6.68		2.11		0.668		0.211		0.0668		0.0211
	66.1		20.9		6.61		2.09		0.661		0.209		0.0661		0.0209
	65.3		20.7		6.53		2.07		0.653		0.207		0.0653		0.0207
	64.6		20.4		6.46		2.04		0.646		0.204		0.0646		0.0204
	63.8		20.2		6.38		2.02		0.638		0.202		0.0638		0.0202
-4dB	63.1	-14dB	20.0	-24dB	6.31	-34dB	2.00	-44dB	0.631	-54dB	0.200	-64dB	0.0631	-74dB	0.0200
	62.4		19.7		6.24		1.97		0.624		0.197		0.0624		0.0197
	61.7		19.5		6.17		1.95		0.617		0.195		0.0617		0.0195
	61.0		19.3		6.10		1.93		0.610		0.193		0.0610		0.0193
	60.3		19.1		6.03		1.91		0.603		0.191		0.0603		0.0191
	59.6		18.8		5.96		1.88		0.596		0.188		0.0596		0.0188
	58.9		18.6		5.89		1.86		0.589		0.186		0.0589		0.0186
	58.2		18.4		5.82		1.84		0.582		0.184		0.0582		0.0184
	57.5		18.2		5.75		1.82		0.575		0.182		0.0575		0.0182
	56.9		18.0		5.69		1.80		0.569		0.180		0.0569		0.0180
-5dB	56.2	-15dB	17.8	-25dB	5.62	-35dB	1.78	-45dB	0.562	-55dB	0.178	-65dB	0.0562	-75dB	0.0178
	55.6		17.6		5.56		1.76		0.556		0.176		0.0556		0.0176
	55.0		17.4		5.50		1.74		0.550		0.174		0.0550		0.0174
	54.3		17.2		5.43		1.72		0.543		0.172		0.0543		0.0172
	53.7		17.0		5.37		1.70		0.537		0.170		0.0537		0.0170
	53.1		16.8		5.31		1.68		0.531		0.168		0.0531		0.0168
	52.5		16.6		5.25		1.66		0.525		0.166		0.0525		0.0166
	51.9		16.4		5.19		1.64		0.519		0.164		0.0519		0.0164
	51.3		16.2		5.13		1.62		0.513		0.162		0.0513		0.0162
	50.7		16.0		5.07		1.60		0.507		0.160		0.0507		0.0160
-6dB	50.1	-16dB	15.8	-26dB	5.01	-36dB	1.58	-46dB	0.501	-56dB	0.158	-66dB	0.0501	-76dB	0.0158
	49.5		15.7		4.95		1.57		0.495		0.157		0.0495		0.0157
	49.0		15.5		4.90		1.55		0.490		0.155		0.0490		0.0155
	48.4		15.3		4.84		1.53		0.484		0.153		0.0484		0.0153
	47.9		15.1		4.79		1.51		0.479		0.151		0.0479		0.0151
	47.3		15.0		4.73		1.50		0.473		0.150		0.0473		0.0150
	46.8		14.8		4.68		1.48		0.468		0.148		0.0468		0.0148
	46.2		14.6		4.62		1.46		0.462		0.146		0.0462		0.0146
	45.7		14.5		4.57		1.45		0.457		0.145		0.0457		0.0145
	45.2		14.3		4.52		1.43		0.452		0.143		0.0452		0.0143
-7dB	44.7	-17dB	14.1	-27dB	4.47	-37dB	1.41	-47dB	0.447	-57dB	0.141	-67dB	0.0447	-77dB	0.0141
	44.2		14.0		4.42		1.40		0.442		0.140		0.0442		0.0140
	43.7		13.8		4.37		1.38		0.437		0.138		0.0437		0.0138
	43.2		13.6		4.32		1.36		0.432		0.136		0.0432		0.0136
	42.7		13.5		4.27		1.35		0.427		0.135		0.0427		0.0135
	42.2		13.3		4.22		1.33		0.422		0.133		0.0422		0.0133
	41.7		13.2		4.17		1.32		0.417		0.132		0.0417		0.0132
	41.2		13.0		4.12		1.30		0.412		0.130		0.0412		0.0130
	40.7		12.9		4.07		1.29		0.407		0.129		0.0407		0.0129
	40.3		12.7		4.03		1.27		0.403		0.127		0.0403		0.0127
-8dB	39.8	-18dB	12.6	-28dB	3.98	-38dB	1.26	-48dB	0.398	-58dB	0.126	-68dB	0.0398	-78dB	0.0126
	39.4		12.4		3.94		1.24		0.394		0.124		0.0394		0.0124
	38.9		12.3		3.89		1.23		0.389		0.123		0.0389		0.0123
	38.5		12.2		3.85		1.22		0.385		0.122		0.0385		0.0122
	38.0		12.0		3.80		1.20		0.380		0.120		0.0380		0.0120
	37.6		11.9		3.76		1.19		0.376		0.119		0.0376		0.0119
	37.2		11.7		3.72		1.17		0.372		0.117		0.0372		0.0117
	36.7		11.6		3.67		1.16		0.367		0.116		0.0367		0.0116
	36.3		11.5		3.63		1.15		0.363		0.115		0.0363		0.0115
	35.9		11.4		3.59		1.14		0.359		0.114		0.0359		0.0114
-9dB	35.5	-19dB	11.2	-29dB	3.55	-39dB	1.12	-49dB	0.355	-59dB	0.112	-69dB	0.0355	-79dB	0.0112
	35.1		11.1		3.51		1.11		0.351		0.111		0.0351		0.0111
	34.7		11.0		3.47		1.10		0.347		0.110		0.0347		0.0110
	34.3		10.8		3.43		1.08		0.343		0.108		0.0343		0.0108
	33.9		10.7		3.39		1.07		0.339		0.107		0.0339		0.0107
	33.5		10.6		3.35		1.06		0.335		0.106		0.0335		0.0106
	33.1		10.5		3.31		1.05		0.331		0.105		0.0331		0.0105
	32.7		10.4		3.27		1.04		0.327		0.104		0.0327		0.0104
	32.4		10.2		3.24		1.02		0.324		0.102		0.0324		0.0102
	32.0		10.1		3.20		1.01		0.320		0.101		0.0320		0.0101