OPERATOR'S MANUAL
MICRO SEVEN, INC®
MODEL LS15-C1
TELEPHONE LINE SIMULATOR

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All requests for repairs should be directed to the factory.

There will be no warranty when the instrument is misused, or when the factory seal on the instrument is broken.

Printed in U.S.A.

Specification and price change privileges are reserved.

ADDENDUM

Non-volatile memory feature of LS15-C1

Programming of parameters are restored upon powering off and on of model LS15-C1 because parameters are protected in non-volatile memory component in LS15-C1. The factory parameters are restored upon dialing "04#".

Hot-line mode in LS15-C1

Hot-line mode setting in LS15-C1 is not restored upon power-off and on because it is difficult to return to non-hot-line mode. This means that hot-line mode may be selected, but hot-line mode will not be returned when turning the power off and on.

INTRODUCTION

Micro Seven model LS15-C, Low cost Telephone Line Simulator, is a small and portable, but it is very powerful telephone line simulator for testing and demonstrating of telecommunication equipment in engineering, manufacturing, and fields. The LS15-C contains dual frequency call progress tones, 20Hz sine wave ring signal, short and programmable telephone number, stutter dial tone, and distinctive ring signals. The LS15-C also contains a line-impairment mode with extra insertion losses. The LS15-C is operated by an provided AC/DC adapter. Car Battery Adapter and 220V version of AC/DC adapter are available as options. The LS15-C is also equipped with a forced-disconnect feature where disconnect signals are sent to calling and called lines. Programmable network response delay simulates time delay after completion of dialing. Simulated PBX mode returns dial tone after dialing 9. The secondary call progress tone generates a single-frequency tone instead of dual-frequency call progress tone. The programmable disconnect signal changes duration of the disconnect-signal. More deluxe versions, model LS15 (battery operated) and model LS15-1 contain caller-ID, caller-ID on call-waiting, battery-feed selection, random noise for line impairment mode, and test tones with programmed parameters restored. All LS15 models including LS15-C are designed in the latest digital technologies as a new-generation type of telephone line simulators, and they do not require calibration.

SECTION 2

SPECIFICATIONS

Dialing:
Telephone numbers:
1. Primary (short) telephone number: selected by dialing 043: 1 for Line 1 and 2 for Line 2.
2. Secondary (programmable) telephone number: selected by dialing 044, detail numbers are 1234567890 for Line 1 and 2345678901 for Line 2.
DTMF dialing signal power: -13dBm to +5dBm per a frequency with no more than 4dB difference between frequencies.
DTMF dialing detection time: 45 ms
Pulse dialing: Break period: 45 to 75 ms (60 ms nominal), make period: 30 to 60 ms (40 ms nominal)

Programming Secondary Telephone Number: dial 02 + (line number) + (telephone number)
Note: Total digits of a secondary telephone number must match with a programmed telephone number length. For detail, see Section 3.16 Secondary Telephone Number Programming.

Telephone Number Length Programming: 0#178*nnn*, where "nnn" is a 3-digit decimal number between 0 and 18. For detail, see Section 3.15 Telephone Number Length.

Simulated PBX Mode:
The following dialing enables the simulated PBX mode where dial tone returns after dialing 9:
0#252*004* with dual frequency call progress tone and 0#252*012* with secondary call progress tone.
To return to non-PBX mode, dial 0#252*000* or dial 0#252*008* with secondary call progress tone.

Line characteristics:
Input impedance at 1 k Hz: 600 ohms +/- 5%
Signal Bandwidth: 150 HZ to 3.5 k HZ
Signal Range: -45 to +5 dBm

Line impairment Mode Programming:
When a number of 00 and line-number is dialed, line impairment circuit with additional 20dB of insertion loss is added to signals between line 1 and 2. The ring signal is generated at the opposite line. Line impairment mode stays on until power is off or non-impairment mode is selected.

Non-impairment mode:

When a number of 09 and a line number is dialed, the insertion loss between lines becomes only 1 dB. This is a power-up default condition. The ring signal is generated at the opposite line. Non-impairment mode stays on until power is off or line-impairment mode is selected.

Battery-feed voltage (loop voltage):   -20 volts:

Ring Signal:
20 +/- 2% Hz sine wave. Normally 2 sec on 4 sec off with exception of distinctive ringing features programmed.
Amplitude: 67V RMS into open circuit. It is 66 V RMS into RN=0.1, 56 V RMS into RN=0.5, 48V RMS into RN=1, and 40V RMS into RN=1.7.
Note: According to the FCC-part 68 rule, the RN=7000/(equivalent resistive value in ohms) for ring signal of 20Hz +/- 3%.
The ring signal at a called line is disabled by dialing *0 and dial the short or long dialing method. To enable back to ringing at a called line, dial *0 again and dial the short or long dialing.

Distinctive ring signal features:
The following distinctive ringing pattern is enabled instead of standard 2 sec on/ 4 sec off ringing pattern:
(a). Dialing 0 * 1 + (line number): 2 sec on/ 4 sec off   (default condition)
(b). Dialing 0 * 2 + (line number): 0.8 sec on, 0.4 sec off, 0.8 sec on, 4 sec off
(c). Dialing 0 * 3 + (line number): 0.4 sec on, 0.2 sec off, 0.4 sec on, 0.2 sec off, 0.8 sec on, 4 sec off
(d). Dialing 0 * 4 + (line number): 0.3 sec on, 0.2 sec off, 1 sec on, 0.2 sec off, 0.3 sec on, 4 sec off

Off-hook impedance requirement: 400 ohms maximum DC, 600 ohms nominal AC

Call Progress Tones:
Dual-frequency call progress tones as a power-up default condition, nominal -16 dBm
Dial Tone: 350 Hz + 440 Hz, continuous unless programmed for stutter dial tone
Ring-back Tone: 440 Hz + 480 Hz, 2 sec ON/4 sec OFF.
Busy Tone: 480 Hz + 620 Hz, 0.5 sec ON/0.5 sec OFF.
Accuracy in frequency component: +/- 1%.

Secondary Call Progress Tones:
Dialing 07 enables the secondary call progress tones. Instead of generating dual frequency call progress tones, single-frequency tone of 480 Hz is produced with signal power of – 18.5 dBm. Dialing 07 switches back to the dual frequency call progress tones.

Stutter dial tone:
Dialing 046 enables stutter dial tone with three of 0.1 seconds on/off period following with continuous dial tone.
Dialing 045 disables the stutter dial tone. It is a power-up default condition.

Line Input Jacks: USOC-RJ11-C, standard modular phone jacks

Power Switch: on when the switch is pushed in, off when the switch is pushed out.

Hot Line Mode: Dialing 06 enables the hot line mode, which calls the other line without dialing a number. To return to non-hot-line mode, dial 06 during the first 0.1 seconds right after off-hook.

Network response delay:
Time delay between the end of dialing and ring-signal application is programmable by the following dialing:
 0#170*nnn*, where nnn is a 3-digit decimal number between 1 and 255. The time delay is determined by 8.6 ms x (nnn-1). The number, nnn, should not be zero.
The power-up default condition is 0 seconds.

Forced called-party disconnect:
When two lines are connected and one line hangs up, disconnect signal is generated to both lines.

Programmable disconnect signal:
The disconnect signal, which is interruption of loop current at the end of call when one line hangs up is programmable by the following dialing:
 0#169*nnn*, where nnn is a 3-digit decimal number between 1 and 255. The time delay is determined by 8.6 ms x (nnn). The number, nnn, should not be zero.
The power-up default condition is 320 ms.

AC/DC Adapter: 117VAC +/- 5%, or 230VAC +/- 5%(for optional 230V AC/DC Adapter)

DC input: 12VDC unregulated, 800mA maximum

Line Status Display: red LED for each line to indicate off-hook status (continuous on) or ringing status (blinking)

Calibration: not required

Power Indicator: green LED display

Dimensions: 19 cm (4") W x 4.5 cm (1.75") H x 10 cm (7.5") L
Weight: 400g (0.8 lbs.)
Environmental: Operating temperature: 0 to 35 degree C, Humidity: 85% RH at 35 degree C
Warranty/Service: 6 months limited warranty. No warranty if any factory seal is broken. Service is performed at the factory, usually within 5 working days.

Options and Accessories:
Car Battery Adapter
230V input AC/DC Adapter (117V input unit is a standard.)

Country of Origin: Manufactured in United States of America

SECTION 3

OPERATION

3.1 AC/DC Adapter and External DC Input Operations

The LS15-C is operated with AC/DC Adapter or Car Battery Adapter (external DC operation). The standard AC/DC Adapter for LS15-C inputs 117V-AC power. The 220V version of AC/DC Adapter is available as an option. The LS15-C does not contain an internal battery unlike model LS15.

3.2 Front-panel Description

The front panel of LS15-C is shown in Figure 3-1.
1. J1 (RJ11-C): Line 1 Input Jack for connection to telephone sets/modems
2. Line 1 OH/BUSY Indicator: LED to indicate ﹁Off Hook﹂ status or ﹁Line busy﹂ condition. It blinks when it is ringing.
3. J2 (RJ11-C): Line 2 Input Jack for connection to telephone sets/modems
4. Line 2 OH/BUSY Indicator: LED to indicate ﹁Off Hook﹂ status or ﹁Line busy﹂ condition. It blinks when it is ringing.
5. Power ON (when the switch is in.) or OFF (when the switch is out).
6. Power LED: on when the power is on.

Figure 3-1 Front Panel of LS15-C

3.3 Rear-Panel Description

The rear panel of LS15-C is shown in Figure 3-2. Connect AC/DC Adapter or Car Battery Adapter to a DC Input connector on the rear panel.

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12V DC INPUT
800 MA MAX.

  O                    MICRO SEVEN, INC.
                       BEAVERTON, OREGON
                       MADE IN U.S.A.
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Figure 3-2 Rear Panel of LS15-C

3.4 First-time AC/DC Operation and Dialing Primary Telephone Number

Use this procedure when turning the instrument on for the first time. The procedure will also serve to explain the operation of the instrument. Here, two telephone sets, or one telephone set and an auto-answer modem, are required as shown in Figure 3-3.
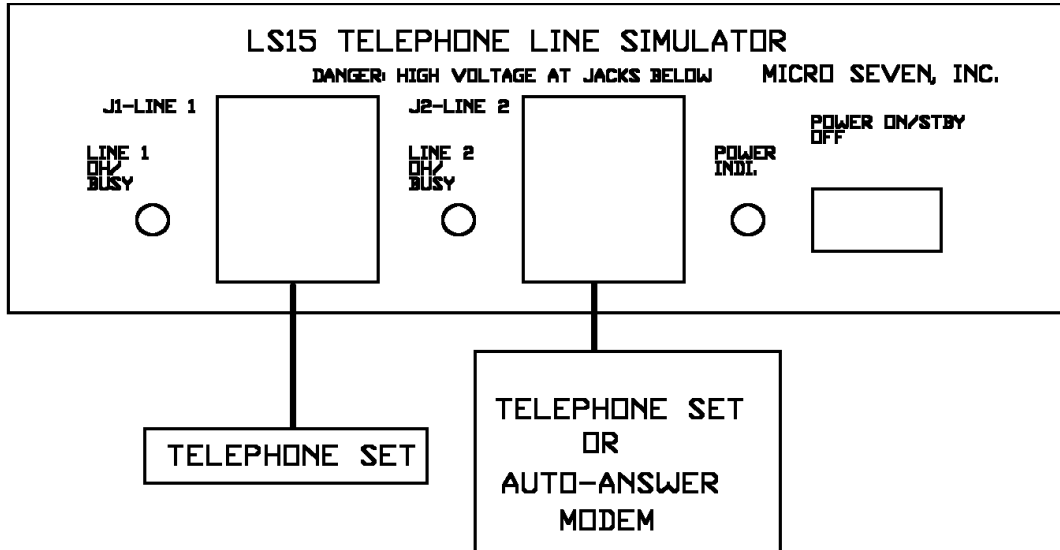

Figure 3-3 Connection for first time operation

Connect AC/DC Adapter to the rear panel DC connector, and apply input power source, 117V or 220V depending on an AC/DC Adapter. Then push the front panel POWER switch in. Observe that the front panel POWER indicator LED comes on. With nothing connected to any of the line-input jacks, the OH/BUSY lights for all lines should be off.

Connect a standard telephone-set, either rotary or tone, to J1. Connect an auto-answer modem or another telephone set to J2. Check that the OH/BUSY lights are still off. If any light is on, check to see if the telephone is off-hook, or the modem is in its off-hook condition.

Lift the Line 1 telephone receiver; the Line 1 OH/BUSY light should come on and the dial tone should be audible at the Line 1 receiver. Assuming that the Primary Dialing method (single-digit dialing as power-up default) is employed, dial a rotary pulse or DTMF "2" at the Line 1 set; after completing the dialing, the ring-back tone should be audible. The high-voltage ring signal is generated at the J2. Observe that the OH/BUSY light for Line 2 is flashing to indicate ring signal.

When the call from Line 1 is answered at Line 2 by closing relay contacts in the modem or lifting the receiver, the ring-back tone at Line 1 and the high-voltage ring signal at Line 2 will be turned off. Observe also that the OH/BUSY light for Line 2 is now steadily on. A signal path has been established between Line 1 and Line 2.

When an auto-answer modem is used at Line 2, it generally waits 2 to 3 seconds before generating a continuous 2.2 kHz answer tone.

3.5 Dialing Secondary Telephone Number

Next, hang up the telephone sets. Lift the Line 1 telephone receiver, and dial "044" to select the Secondary Telephone Number mode, and hang up the receiver. Lift the Line 1 telephone receiver again, dial a rotary or tone "2345678901"; after completing the dialing, the ring-back tone should be audible. And the high-voltage ring signal is generated at the J2 connection. Then hang-up the Line 1 telephone receiver, and dial "043" to return to the Primary Telephone Number. The Secondary Telephone Number is programmable, and the power-up default condition is "1234567890" for the Line 1, and "2345678901" for the Line 2.

3.6 Line-Impairment Mode/Non Line-Impairment Mode

The power-up default condition is non-impairment mode, so dial "002" at the Line 1 telephone receiver to select the Line Impairment Mode and to call Line 2. The Line Impairment Mode adds 20 dB insertion losses for signals between two lines. When the Line 2 answers the call from Line 1, signals between lines are attenuated by 21 dB. After the programming for the Line Impairment Mode is completed, either Primary or Secondary Telephone Number will not affect the Line Impairment programming setting. To select non-impairment mode, dial "09" at either line, and hang up. The random noise, frequency-attenuation characteristic, and envelope delay distortion of signals are not installed in LS15-C.

3.7 Dual-Frequency and Secondary Call Progress Tones

As defined in the Section 2, Specifications, the standard call progress tones in LS15-C including dial tone, ring-back tone, and busy tone are dual frequency call progress tone types as being used in U.S. and Canada. The Secondary Call Progress Tones of a single frequency of 480 Hz may be selected instead of the dual frequency type by dialing 07 and hang up the receiver. The tone duration will not be affected. To return to the dual frequency call progress tones, dial "0#252*000*" for non-PBX mode or "0#252*004*" for PBX mode.

3.8 Simulated-PBX Mode

The Simulated-PBX Mode generates dial tone again after receiving dialing of "9" as dialing "9" is required to access an outside line. To enable this Simulated PBX Mode, DTMF dialing of "0#252*004*" for dual frequency call progress tones or dialing of "0#252*012*" for the secondary call progress tones. Note that dialing "9" is not required to complete dialing; for example, dialing "92" or "2" at the Line 1 will ring the Line2. To return to non Simulated-PBX Mode, dial "0#252*000*" for dual frequency call progress tones or "0#252*008*" for secondary call progress tones. Also note that dialing "9" as a primary telephone number in non-Simulated-PBX mode will generate busy signal.

3.9 Stutter Dial-Tone

By dialing "046", the stutter dial tone is enabled. By dialing "045", it is switched back to non-stutter dial tone. Note that the stutter dial-tone is interrupted at its beginning.

3.10 Hot-Line Mode

The Hot-Line Mode eliminates dialing. When one line goes off-hook and receives dial tone, the other line will be ringing. Dialing "06" enables the Hot-Line Mode, and dial "06" during the 0.1 seconds right after off-hook to disable the Hot-Line Mode.
Caution: Changing back to non Hot-Line Mode is very tricky because requirement of fast dialing. We recommend to turn off the power for returning to non-hot line mode.

3.11 Network Response Delay

The network response delay, that is between the end of dialing and start of ring signal application and ring-back tone generation, may be implemented by dialing "0#170*nnn*" where "nnn" forms a 3-digit decimal number. The delay is determined by 8.64 ms multiplied by a number, "nnn".
For example, by dialing "0#170*255*", the network response delay of 2.2 seconds is obtained.

3.12 Forced Called-Party Disconnect and Programming Disconnect Signal

When two lines are connected and one line hangs up, disconnect signal, which is interruption of loop current, is generated at two lines for 320 ms.

The disconnect signal duration is programmable by dialing "0#169*nnn*, where "nnn" forms a 3-digit decimal number. The duration is determined by 8.64 ms multiplied by a number, "nnn".

3.13 Enabling/Disabling Ring Signal

The ring signal may be turned off at a called line by dialing *0.
To return to normal ring mode, dial "*0" again.

3.14 Distinctive Ring Signal

Instead of the normal ringing interval of 2 sec on / 4 sec off, the following three different ringing patterns are provided:

Pattern 1: 2 sec on, 4 sec off

Dial 0 * 1 + (Line Number), default condition
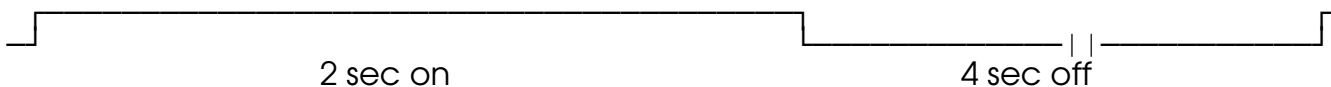
2 sec on   4 sec off

Pattern 2: .8 sec on, .4 sec off, .8 sec on, and 4 sec off

Dial 0 * 2 + (Line Number)

.8 sec on   .4 sec off   .8 sec on   4 sec off
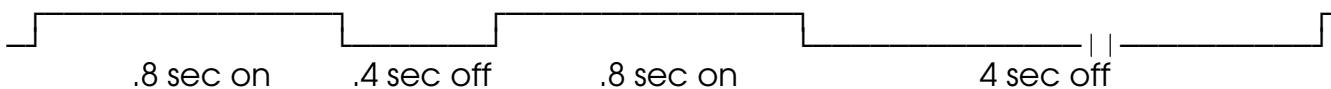
Pattern 3: .4 sec on, .2 sec off, .4 sec on, .2 sec off, .8 sec on, and 4 sec off

Dial 0 * 3 + (Line Number)

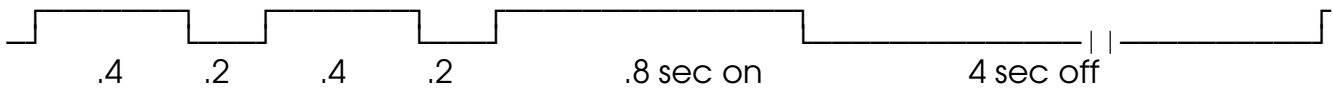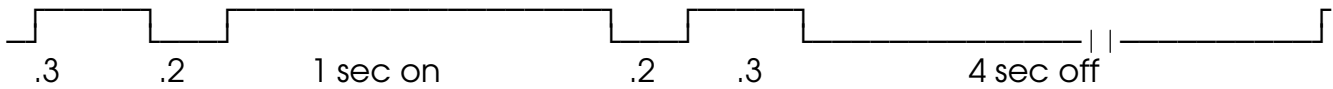.4   .2   .4   .2   .8 sec on   4 sec off

Pattern 4: .3 sec on, .2 sec off, 1 sec on, .2 sec off, .3 sec on, and 4 sec off

0 * 4 + (Line Number)

.3   .2   1 sec on   .2   .3   4 sec off

3.15 Programming Telephone Number Length

Programming for variable length of calling numbers and secondary telephone number is obtained by dialing: 0#178*nnn*, where "nnn" is a 3-digit decimal number between 0 and 18. The maximum telephone number is eighteen digits. The power-up default is set at 10 digits.

3.16 Secondary Telephone Number Programming

The power-up Secondary Telephone Numbers are:
  Line 1: 1234567890
  Line 2: 2345678901

To change the Secondary Telephone Number, dial the following code:

02 + line number + telephone number

Note: The telephone number length is defined in Section 3.15.

Example 1: to program 503-987-6543 as a new secondary number for line 1, dial 0215039876543 upon power-up, and hang up.

Example 2: Program 800-555-1212 for line 2, dial 0228005551212 upon power-up, and hang up.

Example 3: Program 1-800-555-1212 for line 1, 1-503-987-6543 for line 2, dial 0#178*011 (to select 11 digit telephone number), hang up, dial 02118005551212, hang up, dial 02215039876543, and hang up.

SECTION 4

FCC RULES, PART-15

Warning

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Sub-part J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which cases the user at his own expense will be required to take whatever measures may be required to correct the interference.

APPENDIX A

PROGRAMMING SUMMARY of LS15-C

Caution: LS15-C does not restore programmed parameters upon power-up. Please check Micro Seven for the availability of other LS15 models that restore programmed parameters.
Note: "nnn" is a 3-digit decimal number. It must be 3 digit long.

-To select Primary Telephone Number: 043 (Power-up default)

-To select Secondary Telephone Number: 044

-Telephone number length: 0#178*nnn*, 10 digits power-up default

-Programming secondary telephone number: 02 + line number + (new telephone number)
Note: Total digit of a new telephone number must match with a telephone number length.

-Line Impairment mode: 00

-No Line-Impairment mode: 09 (power-up default)

-Distinctive ringing : 0*n where n=1-4

-045: disable stutter dial tone (power-up default)

-046: enable stutter dial tone

-06: switch from/to the Hot Line mode

-07: switch from/to the secondary call progress tone

-0#169*nnn*: disconnect signal programming

-0#170*nnn*: network response delay

-0#252*004* (with dual frequency call progress tones) or 0#252*012* (with secondary dial tone): PBX mode is selected.

-0#252*000* (with dual frequency call progress tones) or 0#252*008* (with secondary dial tone): Non-PBX mode is selected.

-Ring Signal On/Off: *0

APPENDIX B

SIGNAL POWER TABLE (dBm)

1. dBm versus peak-to-peak voltage of sine wave with no harmonic distortion

$dBm = 10 \log_{10}(((\text{peak-to-peak voltage})*0.3535)^2/600E\text{-}3)$

dBm   Peak to-Peak Voltage

dBm	Voltage	dBm	Voltage	dBm	Voltage	dBm	Voltage	dBm	Voltage
10	6.92716	-7	0.97849	-24	0.13822	-41	0.01952	-58	0.00275
9	6.17384	-8	0.87208	-25	0.12318	-42	0.01740	-59	0.00245
8	5.50244	-9	0.77724	-26	0.10979	-43	0.01551	-60	0.00219
7	4.90405	-10	0.69272	-27	0.09785	-44	0.01382	-61	0.00195
6	4.37074	-11	0.61738	-28	0.08720	-45	0.01232	-62	0.00174
5	3.89543	-12	0.55024	-29	0.07772	-46	0.01098	-63	0.00155
4	3.47180	-13	0.49041	-30	0.06927	-47	0.00979	-64	0.00138
3	3.09425	-14	0.43707	-31	0.06173	-48	0.00872	-65	0.00123
2	2.75775	-15	0.38954	-32	0.05502	-49	0.00777	-66	0.00109
1	2.45785	-16	0.34718	-33	0.04904	-50	0.00693	-67	0.00097
0	2.19056	-17	0.30943	-34	0.04371	-51	0.00617	-68	0.00087
-1	1.95234	-18	0.27578	-35	0.03895	-52	0.00550	-69	0.00077
-2	1.74002	-19	0.24579	-36	0.03472	-53	0.00490	-70	0.00069
-3	1.55080	-20	0.21906	-37	0.03094	-54	0.00437	-71	0.00061
-4	1.38215	-21	0.19523	-38	0.02758	-55	0.00390	-72	0.00055
-5	1.23184	-22	0.17400	-39	0.02458	-56	0.00347	-73	0.00049
-6	1.09789	-23	0.15508	-40	0.02191	-57	0.00309	-74	0.00043

2. dBm versus RMS voltage $dBm = 10 \log_{10} (V^2/600 \, E\text{-}3)$

Note: The term "dBm" is defined as a log-scale comparison of signal power into 600 ohms to 1 milliwatts.

dBm   RMS VOLTAGE

dBm	Voltage	dBm	Voltage	dBm	Voltage	dBm	Voltage	dBm	Voltage
10	2.44949	-7	0.34600	-24	0.04887	-41	0.00690	-58	0.00097
9	2.18311	-8	0.30837	-25	0.04356	-42	0.00615	-59	0.00086
8	1.94570	-9	0.27484	-26	0.03882	-43	0.00548	-60	0.00077
7	1.73411	-10	0.24495	-27	0.03460	-44	0.00489	-61	0.00069
6	1.54552	-11	0.21831	-28	0.03084	-45	0.00436	-62	0.00061
5	1.37745	-12	0.19457	-29	0.02748	-46	0.00388	-63	0.00054
4	1.22765	-13	0.17341	-30	0.02450	-47	0.00346	-64	0.00048
3	1.09415	-14	0.15455	-31	0.02183	-48	0.00308	-65	0.00043
2	0.97516	-15	0.13775	-32	0.01946	-49	0.00275	-66	0.00038
1	0.86911	-16	0.12276	-33	0.01734	-50	0.00245	-67	0.00034
0	0.77460	-17	0.10942	-34	0.01546	-51	0.00218	-68	0.00030
-1	0.69036	-18	0.09752	-35	0.01377	-52	0.00195	-69	0.00027
-2	0.61528	-19	0.08691	-36	0.01228	-53	0.00173	-70	0.00024
-3	0.54837	-20	0.07746	-37	0.01094	-54	0.00155	-71	0.00021
-4	0.48874	-21	0.06904	-38	0.00975	-55	0.00138	-72	0.00019
-5	0.43559	-22	0.06153	-39	0.00869	-56	0.00123	-73	0.00017
-6	0.38822	-23	0.05484	-40	0.00775	-57	0.00109	-74	0.00015